PANTHER

EXTERNAL APPEARANCE & DESIGN CHANGES

RODDY MACDOUGALL & MARTIN BLOCK

Abteilung 502

PANTHER

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3

Layout by Roddy MacDougall
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Foreword

This work by Roddy MacDougall is to be commended as it dramatically increases our knowledge of this most important tank.
The Panther, far more than any other German Tank design, has exerted the greatest influence on the battlefield and on the development of the modern battle tank. It deserves to have its history, which was lost in the chaos of 1945, rebuilt. This is another block in that rebuilding.
The late Tom Jentz and I were happy to allow Roddy to use our Panzer Tracts drawings as the basis of his remarkable set of colour plates. Rather than the usual artist's impressions and wishful thinking regarding colour, these colour plates are the results of a methodical scientific study of the changes that took place over time and at each Assembly plant. The plates also catalogue the various methods adopted by the different assembly firms in the application of the anti-magnetic Zimmerit.
It should be noted that this book builds on the previous ground breaking book by Roddy MacDougall and Darren Neely "Nürnberg's Panzer Factory" published in 2013. This gave such an interesting insight into M.A.N the company that was entrusted with overall responsibility of designing the Panther in a remarkably short time.
In 1968 when I worked on my first publication about the Panther Ausf.G (Bellona Military Vehicle Print 16) there was little by way of reference material available. A few Allied War time reports and the Panthers displayed in Bovington and Aberdeen.
So much has improved since then and this book joins a short list specific publications can be seen as building blocks in our understanding of the Panther.
"Der Panzer-Kampfwagen Panther und seine Abarten" which subsequently became available in English and Japanese was written in 1978 Walter Spielberger is still remarkable as it contains so much about the complex automotive development and includes input from senior German officers that had key positions in the Panther project. Oberst Dipl.-Ing. W. Esser who was the director of the Kummersdorf Testing Establishment. Oberst Dipl.-Ing. Th. Icken OKH/AHA/In6 and Oberstlt Dipl.-Ing. Stollberg, Wa. Prüf 6.
After a further 18 years of research Tom Jentz and I wrote "Panther Tank - the Quest for Combat Supremacy" in 1995 to reveal many new facts and debunk many myths. The operational and production history of the Panther was covered in more detail than previously.
With the emergence of Computer Aided Drafting (CAD) and the generous support of private collectors who gave us access to the Panthers and Panther Parts which allowed Tom Jentz and I examine in detail each Panther Ausführung present drawings in four volumes of Panzer Tracts (No.5-1 to No.5-4). These Panzer Tracts did not replace "Germany's Panther Tank - The Quest for Combat Supremacy" but were designed to build on the factual information in that book with details that could not be included and of course new facts from ongoing research.
"Nürnberg's Panzer Factory" brought important new elements in this historical reconstruction and was followed in 2014 when Frank Köhler added his contribution with "Panther – Meilenstein in the Panzertechnik" developing further the technical and automotive theme.
Armed with this book Historians, Enthusiasts and Modeller will be able to: interpret period photographs with much greater certainty, follow the camouflage and marking schemes of the Assembly firms and understand many new details. Well done Roddy!

Hilary Louis Doyle
2016

Introduction

The *Sd.Kfz.* 171 Panther and its variants have been the subject of popular discussion for seventy years. This very capable series of vehicles went from being considered the Panzerwaffe's "problem child" to becoming an iconic symbol of the technical superiority and strength of Germany's armed forces. It was made in significant numbers with *Ausführung* D production totalling 842 vehicles, 2200 Ausführung A Panthers and 2961 *Ausführung* G Panthers produced between January 1943 and April 1945. It is our hope to be able to provide further detail on the various design modifications that affected the external appearance of the Panther series during its production and its issue to front line units. The full technical development and the provision of sets of scale drawings of the *Pz.Kpfw.* V Panther fall outside the scope of this work. For those readers interested in this subject a complete and accurate technical history of the *Pz.Kpfw.* V Panther series can be found in the publications on this subject by Walter J. Spielberger, Thomas L. Jentz and Hilary Louis Doyle. Their work in this field is second to none and is unlikely to be surpassed. No serious study of these vehicles can be undertaken without reference to Germany's Panther Tank, The Quest for Combat Supremacy (Thomas L. Jentz, Hilary Louis Doyle, Schiffer Publishing; 1995), Panzer Tracts No.5-1 to 5-4 (Thomas L. Jentz, Hilary Louis Doyle, Panzer Tracts Publishing; 2003-2006) and Panther und Seine Abarten (Walter J. Spielberger, Hilary Louis Doyle, Motorbuch Verlag; 1987). The dates given in these works form a reliable record for the official notification for design modifications taken from correspondence between the *Heeres-Waffenamt* and the assembly firms. We would like to dispel some of the misconceptions and urban myths that have developed over the years regarding these vehicles courtesy of idle hands, overactive imaginations and in some cases laziness where previous errors are repeated or worse "new" information invented.

We have been able to trace the numbers of Panthers and their date of issue to each of the various units through the examination of original documents. Over the course of this and other projects we have had the opportunity to examine numerous high quality photographs of the Panther *Ausführung* D, *Ausführung* A and *Ausführung* G that were used by various units on the Eastern and Western Fronts along with the vehicles engaged in the Italian campaign. These have been used to trace the approximate date of manufacture for most vehicles and the exact date for others from the *Fahrgestell* number or *Fgst.Nr.* (chassis) stencilled on the vehicles exteriors by the assembly plants and those few records that have survived.

The *Fahrgestell* numbers have also been used to track the dates that design modifications were implemented on completed vehicles at the assembly plants. Throughout this work we have used the dates for the introduction of specific design modifications based on their appearance on completed vehicles rather than the dates the order to execute these modifications were either issued or received as there were many factors that influenced the time scales between the two.

The examination of numerous period photographs led to the conclusion that there was a sense of order within what appeared at first glance, to be a haphazard application of camouflage and markings on these vehicles. We have intend to identify which assembly plants had used specific camouflage patterns and marking combinations which had become apparent during our research and determined that these features could be used to identify where a particular Panther was assembled and when. This was then carefully compared against the surviving Panther *Wannen/Fahrgestell* (hulls) and the photographs taken of them in 1944-1945 to ascertain whether by using the marking and camouflage pattern combinations the various assembly plants could be identified correctly. The results were then checked using the Fahrgestell numbers to give a positive identification of the assembly firm for each vehicle.

We have been very lucky enough to have had access to literally thousands of photographs from numerous sources when researching this project. We have not always been given permission to publish photographs that showed details that were relevant. The price of period photographs have risen dramatically in the last two decades and it is understandable that the owners wish to preserve the value of their investments from the "something for nothing" brigade who will scan and print any new photos prior to selling them on as "original". We have obtained permission and paid the licence fees for all of the photographs that were sought from museums and archives as well as those people who have graciously allowed us to use their photographs. We have also bought original period photographs to use in this publication. Some of these were exchanged for scans that we then ostensibly had permission to use in this book. Sadly, two of those we entered into agreements with took the photos but failed to deliver scans in a quality that could be reprinted or reneged on the use of photographs that had previously been agreed. There is at least one source that has supplied and sold scans of photographs to several authors that have been digitally altered using Photoshop to obscure some details and add others that were never present on the original photographs. There is nothing wrong with removing scratches or blemishes to enhance the clarity of a photograph however, the invention of detail is another thing altogether. The information in these photographs or others from the same source can not be relied on. This has unfortunately tainted the work of these authors who are entirely innocent and were misled when scans of these photographs were sold to them.

Some of the conclusions reached from this original research were first published in Duel in the Mist; the majority of the information was limited to that relevant to the time frame encompassing those Panthers issued to *Kampfgruppe* Peiper in the Ardennes. The continuation of this research has over time allowed us to build up a picture of what features were first introduced by which assembly plant and when. It is our intention to accurately document the appearance, camouflage schemes and factory applied markings from the various assembly plants over the production life of the *Sd.Kfz.* 171 Panther and those units that used these vehicles in combat. We have also included as much information as possible regarding modifications that units have made to all or groups of their vehicles so that these can be readily identified. The information regarding camouflage schemes, factory applied markings and build features is relevant to all of the vehicles from a particular assembly plant and time frame, so that it is relevant to vehicles that served on all of the fronts.

It is our intention to document the history of the various units that used the Panther in combat against the Western Allies as well as Soviet forces on the Eastern Front in future volumes. The engineering firm Maschinenfabrik Augsburg Nürnberg (M·A·N) had originally designed the Panther series and would retain design responsibility for this and the *Fahrgestell* when used on other vehicles such as the Jagdpanther series. As Germany's position deteriorated and the Allies advanced further into German territory in early spring 1945, the *Heeres-Waffenamt* ordered the design team at the M·A·N offices at Ansbach to destroy all of the drawings and correspondence relating to war production. The majority of the surviving documentation on the design of the Panther recovered by the Western Allies came from the Maschinenfabrik Niedersachsen Hannover (M.N.H.) plant at Hannover, Linden. This documentation detailed the design instructions communicated to M.N.H. by the *Heeres-Waffenamt*. It should be noted that the dates given in the publications listed above for modifications to the design are either the official dates that orders were issued or received at the assembly plant or the dates from this correspondence that vehicles with these modifications present were known to have been completed. They do not provide the dates that all of the vehicles at all of the assembly plants were completed with the relevant modifications present. Another factor to consider is that not all of the assembly plants had identical contracts or implemented design modifications at the same time so that there would be certain features missing on vehicles from one assembly plant produced at the same time as vehicles from another plant where the design modifications had already been implemented. New components and design modifications are often trialled to test their suitability for inclusion into full series production. This resulted in Panthers that have these features or design modifications being assembled and issued to the troops prior to the official instructions being issued to implement these modifications.

The instances where this has happened are isolated to a very small number of vehicles. There are a very small number of period photographs that show unusual non standard components or components fitted to Panthers for which there is no surviving documentation. It is likely that these show proposed design modifications that were superseded, found to be impractical or were rejected by the troops. The delay between receiving any instruction and making the modifications to vehicles still on the production lines meant that it would often take some weeks before vehicles with design modifications were completed and delivered to the troops. A further factor was that not all the assembly plants were instructed to implement certain design modifications. There is insufficient information to explain why this occurred but there is no doubt that it did indeed happen.

The term assembly plants is used extensively when referring to the main companies involved in the Panther Programme because they manufactured very little themselves and assembled components delivered to them by an extensive array of specialised sub contractors to produce the Panther. The sub contractors were given a component drawing and specification that they then used to develop the pattern for the parts that they supplied. The differences in sub components and particularly cast items usually has more to do with the number of contractors supplying these parts and the amount of material milled from the component to finish it than it has to do with it being a completely different design or sub type as the drawing numbers for these parts rarely changed and almost all of these are already documented. The main assembly plants involved in series production of the Panther were Maschinenfabrik Augsburg Nürnberg (M·A·N), Henschel, Maschinenfabrik Niedersachsen Hannover (M.N.H.), Demag and Daimler-Benz. Contracts for series production of the *Ausführung* D were issued to M·A·N, Daimler-Benz, M.N.H. and Henschel who would all commence assembly of the Panther in January 1943. When production switched over to *Ausführung* A, the assembly plant that would still be involved in series production did so almost simultaneously in September. M.N.H. would start assembly of the new design a few weeks earlier completing their first 3 *Ausführung* A at the end of August 1943. Henschel would drop out of series production of the Panther completing its last ten *Ausführung* D in September 1943. As Henschel dropped out the engineering firm Demag would start series production of the *Ausführung* A in September 1943. In contrast, the introduction of the *Ausführung* G would be staggered at three of the assembly plants that had previously assembled the Panther *Ausführung* A, M·A·N, Daimler-Benz and M.N.H. This is quite important as new Ausführung A Panthers were still being completed and delivered to the troops more than 4 months after the first *Ausführung* G was completed. We have followed the correct chronological order for the design changes on completed vehicles so that changes that were being introduced on the last *Ausführung* A are still being discussed after the introduction of the *Ausführung* G.

There are several people who we must thank as this project would not be what it is without their help and assistance. First, we would like to thank Hilary Louis Doyle and the late Thomas L. Jentz for their encouragement and enormous practical help without which you would probably not be reading this. We would also like to thank the late Bill Auerbach who was always highly supportive of this project, Lee Archer, Darren Gawle, Manus Gallagher, Mike Gibb, Timm Haasler, Oliver Fein, Gunnar Jansson, Brian Murdoch, Jean-Michel Delvaux, Frank Köhler, Eddy Monfort, Dieter

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Roddy MacDougall & Martin Block

1. GENESIS OF THE PANTHER PROJECT

On 22nd June 1941 Operation Barbarossa, the invasion of the Soviet Union began; it was not long before various Panzer units started to report their first encounters with the Soviet T-34 tank. This new tank was something of a surprise to the *Wehrmacht* High Command who had previously been unaware of this technically advanced design. The *Heeres-Waffenamt* had previously been working on designs for vehicles in the 30ton class[1] but as there were no known adversaries that were technically superior to the Pz.Kpfw. III and IV then in service, this had not been pursued with vigour. In any case even if these designs had been available to the troops they would not necessarily be more effective than the Soviet T-34[2].

Work on these designs was halted and a special *Panzerkommission* was quickly set up in autumn 1941 to develop a new design of Panzer intended to be not just an equal to the T-34 but be a further step up the evolutionary ladder. Two firms were selected to submit designs for the new vehicle which saw M·A·N competing against Daimler-Benz for the contract for this important new vehicle. Both firms were awarded contracts to develop their design proposals on 25th November 1941. The two designs were evaluated in early 1942 and the design proposal by M·A·N would be selected for series production on 14th May 1942[3]. The design engineers at M·A·N had gained an enviable reputation for producing technically innovative products that were both efficient and practical. The company's designers had become involved in armaments production, design and development as Germany's armed forces expanded during the early 1930's. By 1942 M·A·N and its parent company GHH were important contractors for the German war effort, despite a very stormy relationship with the NSDAP, supplying armoured vehicles, Diesel engines, steam turbines, locomotives and trucks from their various facilities. They also worked as sub contractors manufacturing specialised components for other business's small arms and artillery as well as carrying out technical development for various manufacturers. This breadth of capability and experience would enable them to go from a blank drawing board to a working prototype in a year[4].

Dipl.-Ing. Paul Max Wiebicke

The talented automotive design engineer Dipl.-Ing. Paul Max Wiebicke led the M·A·N team working on the design of the new tank. Dipl.-Ing. Wiebicke was born in 1886 and had worked at Daimler-Benz and Büssing prior to joining M·A·N in 1916 at Augsburg where he worked on the Saurer patent truck and helped to develop the Diesel engine before moving to Nürnberg in 1923 where he specialised in Diesel engine and commercial vehicle chassis design. He was known to be a quiet and modest man who had a firm understanding of all of the elements of automotive design. This enabled him to quickly adapt to working on different vehicle and engine types at M·A·N. He designed and developed several innovative advancements in Diesel engine technology which provided significant benefits in terms of power outputs and fuel efficiency. Amongst his achievements were patents for the design of a new "globular combustion chamber" on 2nd May 1938 (patent number 2190537), a "fuel injection plug-nozzle" on 27th July 1938 (patent number 2183284) and a "nozzle assembly for Diesel motors" on 21st August 1940 (patent number 2305801). Another important development was the design of a particular truck rear axle with the final spur gear contained within the wheel hub.

Dipl.-Ing. Wiebicke was the head of chassis and engine design in the commercial vehicle department at the M·A·N plant in Nürnberg. He continued to work on the company's core business of commercial vehicle engine and chassis design while working on the design of the Panther from late 1941 on when the M·A·N Panther design department was moved to the *Markgräfliche Residenz* (Margravial Residence) in the town of Ansbach which is 47km south west of Nürnberg. This Panzer is generally acknowledged to be the best tank design produced by all of the combatant nations during World War II. This is all the more impressive when the exceptionally short design and development period is considered. Dipl.-Ing. Wiebicke would continue to

1 The VK 30.01.

2 Spielberger and Doyle: *Panther und Seine Abarten*.

3 The full technical development of the Panther falls outside the scope of this work, for those readers interested in this subject it is covered in depth in the following publications: Jentz and Doyle: *Germany's Panther Tank, The Quest for Combat Supremacy*, Jentz and Doyle: *Panzer Tracts No.5-1 to 5-4: Panzerkampfwagen Panther Ausf D. to Ausf. F.* and Spielberger and Doyle: *Panther und Seine Abarten*.

4 *NSDAP* and *Gestapo* officials conspired and almost succeeded in having Paul Reusch, the Chairman of GHH management board, arrested in 1942 for amongst other things "subverting the war effort". Following this he felt he had to resign from his positions at the company in order to reduce the external pressure on the company.

Otto Meyer, the General Manager at M·A·N was also pursued by the *NSDAP* and *Gestapo* because his wife was Jewish. Mr. Meyer arranged for her to leave the country along with their children who were also considered Jewish to live in neutral Switzerland for the duration of the war. Mr. Meyer was under such pressure from the *NSDAP* that he was even ordered to report to the *Organisation Todt* for street clearing work in 1945.

make a significant contribution to automotive design at M·A·N following World War II where he continued his work on engine and chassis design as well as agricultural tractors up to his death in 1951.

There is little doubt that the double torsion bar suspension system was a major contributory factor in the Panther's success as a combat vehicle. This design feature was developed by the talented engineer Ernst Lehr.

Dr.-Ing. Ernst Lehr

Dr.-Ing. Ernst Lehr was born on 7th April 1896 in Großeichen (Oberhessen). He attended the Humanistic Gymnasium in Friedberg, and then studied mechanical engineering and electrical engineering at the Technical University of Darmstadt. His most important teachers were Viktor Blaeß and Enno Heidebroek. He participated in World War I as an artillery officer. In 1922, he obtained a diploma after passing his exam and entered employment as a development engineer with the firm Maschinenfabrik Carl Schenck A.G. in Darmstadt where he worked in the fields of balancing technology and vibration drives. In 1924, he designed a high-frequency tension-compression machine using resonance principles, dynamic material testing instruments, test machinery for determining the rotary fatigue strength of large structural components and equipment capable of conducting extended torsion and vibration fatigue tests. Inspired by this work, Dr.-Ing. Lehr identified "fatigue" as the limit of alternating force that cannot be endured by a component without its failure. He conducted extended tests using his specially designed equipment to determine the specific fatigue limits of different material types under cyclic axial, torsional and bending stress, recording details of the *Wöhler*[5] curves. Dr.-Ing. Lehr found that the fatigue strength of components could decrease as a result of their mass, surface texture and shape. His new concept of the fatigue strength of materials and the factors that influenced this was the subject of his acclaimed doctoral thesis of 1925. Dr.-Ing. Lehr continued his work determining the number of cycles necessary to induce fatigue in various metal types. He created a set of table that could be used by engineers to aid their calculations that were published in 1926. As a result of his work and a thorough understanding of the mathematical theory influencing oscillation and vibration, Dr.-Ing. Lehr was appointed to the "*Darmstädter Schwingungstagung*" in 1928. Continuing his research, he discovered there were common principals governing mechanical vibrations and electrical oscillations. Dr. Lehr's findings were used to develop practical instruments, such as the dynamic strain gauge and the electrical strain gauge which are still in use today. These devices have gained importance in the practical testing of components such as machine casings, piston rods or crankshafts as well as major structures like bridges and ships. Using these strain gauges Dr. Lehr deduced that the highest stress in a component part could be five times higher in one particular zone than on the load imposed on the rest of the component. In addition to his work with strain gauges Dr.-Ing. Lehr also worked on the use of lacquer for stress crack analysis in metal components along with Dr.-Ing. Otto Dietrich (1890-1942). They conducted tests on aluminium crankshafts, connecting rods and pistons at the engine manufacturer Maybach's premises at Friedrichshafen in 1932.

In 1935 Dr.-Ing. Lehr was appointed as the Director of Mechanical Engineering and Technology at the "*Staatliche (Preuß.) Materialprüfungsamt"* (the Prussian state Materials testing office) in Berlin-Dahlem. Here he expanded his research to the practical determination of the stress distribution in complex form components and the variation of forces in fast moving machine components. He worked on theory of vehicle suspension and the load capacity of compressed materials. At the same time he supervised tests conducted for the *Heeres*-W*affenamt* (Army Ordnance Office) by Siemens and the locomotive manufacturer Borsig in Berlin. Dr.-Ing. Lehr also worked as a lecturer at the Technical University of Berlin, where he habilitated in 1936.

During Dr.-Ing. Lehr's time in Berlin and the *Heeres-Waffenamt*, he was known to be openly critical of the National Socialist Regime. This came to a head in 1938 when his position at the *Heeres-Waffenamt* became untenable. At the insistence of Dr.-Ing. H. Waas, the senior development engineer at the *Oberkommando der Kriegsmarine* (Naval High Command), Dr.-Ing. Lehr created and led the "*Forschungsanstalt für Mechanik und Gestaltung*" (Research Institute for Mechanics and Design) for German marine engine manufacturers at the M·A·N plant in Augsburg in 1938. He was able to bring what had been his staff in Berlin, Fritz Ruef, Walter Willms, Heinz Brätsch and the mechanical engineer Alfred Skiba, to work with him. Dr.-Ing. Heinrich Ernst Kniepkamp was the senior engineer at *Heeres-Waffenamt Prüfung 6* or *Wa.Prüf 6* (Panzer and Motorized Equipment Branch), he valued Dr.-Ing. Lehr's expertise and ability in the field of vibration, damping and metal fatigue. Mr. Kniepkamp had worked as a design engineer at M·A·N from 1923 to 1926 prior to entering government service and he helped ensure there was no political interference when Dr.-Ing. Lehr was appointed to lead the "*Forschungsanstalt für Gleiskettenfahrzeuge*" (Research institute for tracked vehicles) at the M·A·N plant in Nürnberg. Dr.-Ing. Lehr would have considerably more freedom to continue his work following the move from Berlin[6]. Dr.-Ing. Lehr built test equipment at Augsburg that was considerably larger than anything previously envisaged in order to thoroughly test the very large components then being produced by industry. At the Nürnberg laboratory he developed torsion bar suspension systems with large arcs of travel for heavy vehicles. These systems would go on to be used on numerous armoured vehicles including the Panther. Dr.-Ing. Lehr was appointed "*Leiter des Forschungskreises Federung und Dämpfung von Gleiskettenfahrzeugen bei der Kraftfahrzeugkommission des Reichsministers für Rüstung und Kriegsproduktion*" (Head of the suspension and damping of tracked vehicles research council for the Automotive Commission of the Reich Minister for Armaments and War Production) from January 1944 on. Dr.-Ing. Lehr and his Nürnberg assistant Ulrich Bertschinger were tragically killed in an Allied

5 The celebrated German engineer August Wöhler who pioneered the scientific investigation of metal fatigue in the 1850's.

6 Allied interrogation of former *Heeres-Waffenamt* employees held at the NARA and the Imperial War Museum.

air raid on Berlin-Lichterfelde after they were called to a meeting at the *Heeres-Waffenamt* Offices in the city on 24th March 1945. His laboratory in Augsburg was so technically advanced that it was dismantled by U.S. forces and shipped to the U.S.A. for further evaluation in 1946[7].

Sadly, despite their achievements both of these remarkable men are almost unknown today yet the very real advances in engineering they introduced are recognised worldwide.

Versuchsfahrgestell

The *Heeres-Waffenamt* issued a contract to M·A·N in 1942 to assemble two Panther *Versuchsfahrgestell*, when completed these *Fahrgestell* had several features that were unique to them. They were fitted with the initial road wheel design that had 18 rim bolts and a *Kettenantriebsrad* (drive sprocket) that had the toothed ring secured with 16 bolts. The hub was protected by a relatively complicated forged *Deckel* (armoured hub cap) that had the centre boss welded in place. This was in turn secured to the *Kettenantriebsrad* with two bolts that had a sheet metal locking tab. The 6 spokes on the *Kettenantriebsrad* casting had a concave cross section. The engine deck fitted to both of these vehicles was also unique and displayed features indicating a substantial redesign of the motor compartment after fabrication of these parts at the armour manufacturer was already under way. Amongst some of the features indicating this is an access port between the motor cover hinges that has no component underneath. The armoured exhaust fan castings incorporated extensions that were originally designed to protect the individual radiator filler port apertures from Maybach's original design proposal for the engine compartment. These vehicles were also fitted with an exhaust system that had the exhaust gasses from both banks of cylinders discharging into a single horizontally mounted baffle. This baffle was fitted with a sheet metal shroud to provide an element of protection from the heat this system generated.

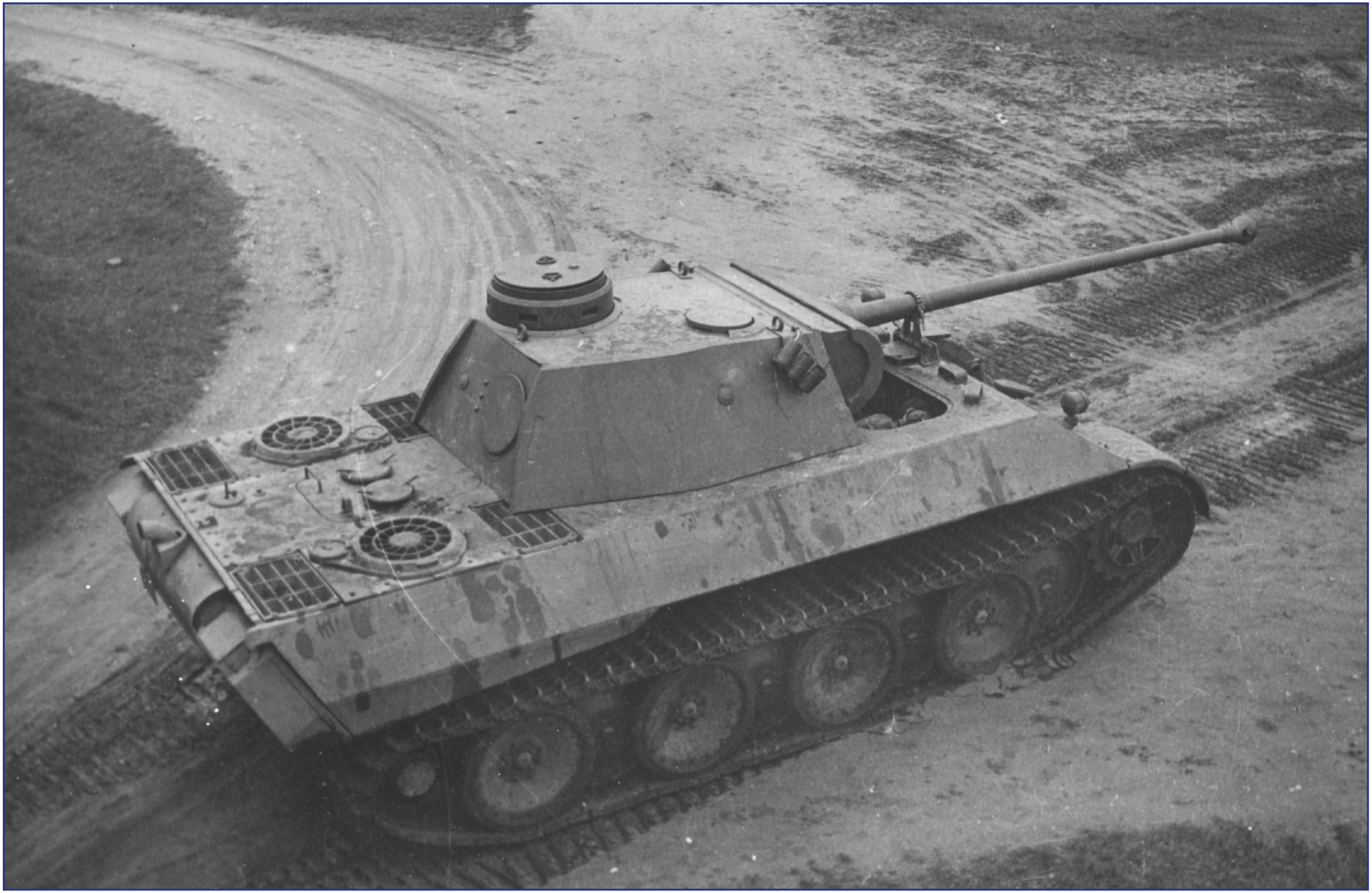
The mild steel plates that were used to fabricate the *Wannen* for the Panther *Versuchsfahrgestell* were butt jointed rather than interlocked and the glacis plates were 60mm thick which conformed to the original design specification issued by the *Heeres-Waffenamt*. The front fenders fitted to Panther *Versuchs Fgst.Nr.V1* was a large single piece design that was devoid of any stamped reinforcing ribs[8], Panther *Versuchs Fgst.Nr. V2* was fitted with what would become the standard fenders on the series production *Ausführung* D and A. The mild steel *Rheinmetall* designed *Türme* (turrets) fitted to these vehicles were also unique to these Panther *Versuchsfahrgestell*. A convex armoured bulge was welded on to the port side of these *Türme* to accommodate the commander's cupola. The front lifting points were incorporated in to mounting brackets for the *Nebelwurfgerät* (smoke grenade launchers). There were minor detail differences between both of these *Türme* such as the location of the conduit for the electrical firing cables for the *Nebelwurfgerät* which can be used to distinguish the two *Türme*. The 7.5cm Kw.K.42 L/70 guns mounted on the *Versuchstürme* were fitted with single baffle globular muzzle brakes. The original road wheels had the rims secured by 18 rim bolts, this road wheel design would be replaced by a new model with 16 rim bolts on series production Panthers. This revised design would soon prove to be inadequate for the task of securing the rubber tyre and its retaining rims to the wheel during prolonged use.

7 Ernst Lehr in Graf von Seherr-Thoss: *New German Biography 14*.

8 These fenders would later be used on a Pz.Bef.Wg. Panther *Fgst.Nr.* 210137, this vehicle was sent to Kummersdorf for test and development purposes and was not accepted for service with the *Wehrmacht*.

Opposite Page:
Hainberg is around 11km south west of Nürnberg; the River Rednitz runs along its north and east perimeter and separates it from the village of Gebersdorf. The town of Zirndorf is on the North West boundary with the villages of Altenberg and Unterasbach on its western perimeter. It covers an area of approximately 213 hectares which for a training area is relatively small. As It was already a secure location its proximity to the M·A·N Nürnberg plant along with the low water table and well drained sandy soil made it an ideal location for comprehensive trials and development work. Hainberg was also used for the extensive tests that formed part of the delivery procedure (*Abnahmestelle*) before new vehicles were delivered for service with the Wehrmacht. The Panther *Versuchsfahrgestell* Nr. V2 was photographed during trials conducted at Hainberg on 5th November 1942 by M·A·N employees. The vehicle was finished in a base coat of Dunkelgrau RAL 7021 paint which was the standard colour for Wehrmacht vehicles at the time. It is fitted with one of the Rheinmetall *Versuchstürme* which had a curved bulge in the port side armour to accommodate the cupola. This photograph affords an excellent view of the original exhaust arrangement that is unique to the two *Versuchsfahrgestell*. This would be replaced with twin vertical exhaust stacks on series production Panthers. The fuel filler cap is on the port side of the rear of the engine compartment cover with the key used to open it in place. The hinge for the hatch on the commander's cupola can be seen above the vision block on the port side of the cupola, this was later moved to a more convenient position further forward on the port side of the cupola. During series production due to its ergonomic inefficiency. There was no lock or retaining catch for the loader's hatch on the initial design, these would later be back fitted to series production vehicles. (Johann Buchner M·A·N)

There was no roof plate installed over the driver and radio operator's position during this test drive. We can see that the driver's armoured visor and the armoured cover for the hull mounted MG.34 machine gun are fully functional on *Versuchs* Panther *Fgst.Nr. V2*, this was not the case on Versuchs Panther *Fgst.Nr. V1* where the apertures were present but had not been machined for fitting the armoured visor and MG cover. A boarding ladder has been bolted directly to the port side considerably easing access to and from the vehicle. The Wanne was redesigned to provide better protection for the crew with the thickness for the new interlocked glacis plate increasing from 60mm to 80mm. (Johann Buchner M·A·N)



This elevated view of the *Versuchs* Panther Fgst.Nr. V2 reveals some interesting features on the engine deck and Turm roof. The engine exhaust fan castings have the integral ports for the radiator filler caps; the design was changed for series production vehicles where the filler cap was moved to a central location at the rear of the deck. As there was already a stock of these castings they were modified by flame cutting the filler cap section before they were installed on the initial Panthers in the production series. The motor compartment's hatch has the early ventilator covers which had two protruding adjustment handles. The conduits for the *Nebelwurfgerät* smoke grenade launchers are forward of the brackets and the lifting points which are welded to these brackets. (Johann Buchner M·A·N)

The *Versuchs* Panther *Fgst.Nr. V2* was finished in a base coat of *Dunkelgrau* RAL 7021 paint which was the standard colour for *Wehrmacht* vehicles at the time. It is fitted with one of the Rheinmetall *Versuchs Türme* which had a curved bulge in the port side armour to accommodate the cupola. These two *Türme* were fabricated by Rheinmetall differing only in minor details such as the lifting points and conduit apertures for the *Nebelwurfgerät* smoke grenade launchers on the *Turm* roof. There were two *Versuchs* Panther *Fahrgestell*, as with the Türme there were minor differences in the fittings and details that can be used to identify whether it is *Fgst.Nr. V1* or *Fgst.Nr. V2* that appears in any particular photograph. (Johann Buchner M·A·N)

The vehicle has a Nürnberg number plate IIN 0687 strung between the hull side towing eye extensions. The vehicle's *Fahrgestell* number "2" has been stencilled on to the glacis plate as was the practice with armoured vehicles completed by M·A·N. It has most of the features that would later be adopted on the production series including the early pattern Kgs64/660/150 single link track design without *Gleitschutzpickeln*. The prominent circular marks with horizontal grooves on the face of the gun mantle are caused by the removal of excess material from the face of the casting. This was required as a result of the mold design which left two raised circular plateaus on the mantle's face which could under certain circumstances form a shot trap. The *Heeres-Waffenamt* inspectors at the armour manufacturers ensured these were removed before accepting the part. (Johann Buchner M·A·N)

Both of the Panther *Versuchswanne* were fabricated in unarmoured mild steel plates without interlocking joints in which is apparent in this side view. The road wheels had 18 rim bolts rather than the 16 used on the production series which were subsequently found to be too weak and had to be reinforced until wheels with 24 rim bolts became available in late summer 1943. The dovetail interlocking front armour casting for the Rheinmetall *Versuchsturm* was 80mm thick; a new Turm was designed which incorporated a 100mm front plate casting for the series production Panthers. The 6 spokes on the *Kettenantriebsrad* (drive sprocket) casting had a concave cross section which was unique to the two Versuchs Panthers. (Johann Buchner M·A·N)

2. SERIES PRODUCTION AND INSPECTION PROCEDURES

It would be wrong to describe the M·A·N plant in Nürnberg, Henschel at Kassel, Demag at Berlin-Albrechtshof, Alkett in Berlin, Daimler-Benz in Berlin-Marienfelde or M.N.H. at Hannover-Linden as a Panzer manufacturers, they did indeed produce Panzers but they would best be described as assembly firms. The production of Panzers involved numerous companies and organisations from the design of the vehicle to its series production. The majority of the components were sourced from specialist sub-contractors and would then be assembled by the main assembly firms awarded the contract to do so by the *Heeres-Waffenamt*.

Throughout the design and manufacturing process every effort was made to maintain very high standards of quality control that would ensure the finished product delivered to the troops was the best that could be manufactured. Specialised jigs along with boring and milling machine tools that once set prior to commencing manufacture ensured accurate dimensions and tolerances were designed and manufactured by M·A·N. Several of the tools had been specially designed solely for one purpose and operation. Amongst those used for machining the *Wanne* was a milling machine for finishing the final drive facings. Another machine tool was used for boring the flame cut holes for the torsion bars whilst an additional tool was used to precision bore the steering box and *Leiträder* (idler wheels) housings. These machine tools would be supplied to all of the assembly firms involved in series production of the Panther. The employment of these special single purpose machine tools, which, having been assembled and set up for the particular task they were designed to perform, needed only periodic checks to ensure that no wear had occurred obviated the need for individual scrutiny of the machining. Other machine tools that would be needed to assemble this large vehicle that were not readily available in Germany at that time would be sourced from firms in the occupied countries in order to ensure that volume production commenced as soon as possible.

An inspection regime was developed by the *Wehrmacht* under the auspices of the *Heeres-Abnahmestelle* (the Army Acceptance Organization) a branch of the *Heeres-Waffenamt* to ensure the highest possible quality control standards on the weapons and vehicles supplied to the troops. This was adapted to suit the assembly of the Panther in conjunction with M·A·N who had overall design responsibility for the Panther Programme to ensure consistency across all of the assembly plants involved in this vehicles manufacture. This inspection program would evolve in response to events as series production got under way revealing areas that needed more rigorous checks etcetera. As production gathered pace the inspection criteria became stricter and was particularly vigorously enforced once series production of the *Ausführung* A had commenced to ensure the best material reached the troops. Quality control was exercised through a carefully controlled series of main inspections undertaken by *Wehrmacht* officers specially trained for this task by the *Heeres-Waffenamt* whose authority they represented. The *Heeres-Waffenamt* inspectors were superimposed over the contractors or assembly plants own inspection team and were the most authoritative body within the works organisation. This *Wehrmacht* officer normally held the rank of *Hauptmann* (Captain) and was usually assisted by an *Oberleutnant* (Lieutenant). All of these men were experienced armourers who underwent special training prior to taking up duties at the plants producing material for the *Wehrmacht*. The special training given to these men was very thorough and ensured they fully understood the importance of the tasks that would be assigned to them. Each of these inspectors had an individual stamp that was used to mark the material that they inspected and approved. This in conjunction with the detailed *Lieferschein* and *Heeres-Abnahmestelle* documentation allowed the origin of components and their original inspectors to be easily traced. These officers were responsible for the final tests and acceptance of the completed vehicle or its components. It cannot be emphasised enough that the *Heeres-Waffenamt* inspectors at the plant had the final say in all matters relating to quality control and the acceptability of components. Their word was considered absolute law and there was never any suggestion of questioning the decisions made by these men.

There would also be a certain number of civilian examiners employed by the assembly firm or component sub-contractor working on routine checks or delegated inspections[1]. The parts these men inspected would subsequently be incorporated into a larger sub-component which would then be checked by the *Heeres-Waffenamt* inspector assigned to that plant prior to his passing the component and stamping it to indicate it had reached the required standard.

A number of the larger or more complex components were sourced directly by the *Heeres-Waffenamt* on a separate purchase contract and then supplied to the assembly plants on a "free issue" basis. These components which were owned by the *Wehrmacht* were kept in bonded stores that were staffed by members of the *Wehrmacht*. They would only issue them to the workforce on receipt of a written instruction which recorded the details of the vehicle that the component would be installed in. All of this information would subsequently be recorded in the *Lieferschein* document that would be completed as part of the *Heeres-Abnahmestelle* inspection undertaken as the vehicle was being assembled and during its final acceptance inspection for service with the *Wehrmacht*. The sub-components sourced directly by the *Wehrmacht* were inspected and stamped by the *Heeres-Waffenamt* inspectors at the original manufacturer's premises.

1 The inspectors employed by M·A·N were allowed to conduct significantly more delegated inspections than the other assembly plants involved in the Panther Programme.

The mechanical components were run for functional tests that were applied to all mechanical sub-assemblies and assemblies that could be run prior to installation or delivery to the assembly firm. The inspection criteria for these components were rigorously enforced by the *Heeres-Waffenamt* inspectors who were present during all of these tests. Several different types of specialised rigs and stands that allowed full functional testing and inspection of the traverse gears, elevation gears, final drives, gearboxes and steering units were designed and fabricated by the component manufacturers and the assembly firms. Where possible these tests were carried out at the component manufacturer's premises prior to the despatch of the unit to the vehicle assembly firm for inclusion in the completed vehicle. The component would be checked on its arrival at the assembly plant to ensure the presence of this stamp prior to its entry to the *Wehrmacht* inventory at the plant. This method of stock control ensured that no further inspection was necessary prior to the installation of these parts. They would be checked again during the *Heeres-Abnahmestelle* inspection to ensure the original inspectors stamp was present. No sub-component would be fitted to the vehicle without a *Heeres-Waffenamt* inspectors stamp. This ensured the quality of the components as well as contributing to efficient stock control at the assembly plants. The stamp and casting/component number would, depending on it location, have a thin white or red rectangle applied around it so that it could easily be found by the *Heeres-Waffenamt* inspectors during the *Heeres-Abnahmestelle* procedure.

Inspections were carried out according to detailed guidelines called "*Technische Lieferbedingungen*" or TLs (Technical Specifications for Delivery) prepared by the various *Waffenprüfämter* or *Wa.Prüf* departments.

- *Wa. Prüf - Amtsgruppe für Entwicklung und Prüfung* (Development and Testing Group)
- *Wa. Prüf 1 - Bewaffnung und Munitionsabteilung* (Weapons and Ammunition Branch)
- *Wa. Prüf 2 - Infanterieabteilung* (Infantry Branch)
- *Wa. Prüf 4 - Artillerieabteilung* (Artillery Branch)
- *Wa. Prüf 5 - Pionier- und Eisenbahnpionier-Abteilung* (Engineering and Railway Engineering Branch)
- *Wa. Prüf 6 - Panzer- und Motorisierungsabteilung* (Panzer and Motorized Equipment Branch)
- *Wa. Prüf 7 - Nachrichtenabteilung* (Signals Branch)
- *Wa. Prüf 8 - Abteilung fur Optik, Messwesen, Heereswetterdienst, Feuerleitung und Kartendruck* (Branch for Optical, Survey, Meteorological, Artillery Fire Control and Map Printing Equipment)
- *Wa. Prüf 9 – Gasschutzabteilung* (Gas Protection Branch)
- *Wa. Prüf 11 - Abteilung fur Sondergerät* (Special Equipment Branch)
- *Wa. Prüf 12 - Abteilung fur Versuchsplätze* (Proving and Testing Grounds Branch)

All the component parts belonging to a specific tank series like the Panther were given *Gruppen* numbers that correspond to the specific drawing for that component. These numbers were broken into a three digit prefix which referred to the type of vehicle which in the case of all armoured vehicles types was the prefix 021. This was followed by the either one or two letter code. The letter code "St" which referred to a standard sized general arrangement drawing, the alternative the letter codes were all single letters A to F which corresponded to a particular size and scale of drawing that provided additional detail for the component. A group of five numbers followed this, the first three digits of this related to a specific vehicle type and series, the last two digits identified the specific component group. If the component group consisted of several parts then these would be indicated by a hyphen followed by numbers that would be used to identify one of the parts. If the component group contained a sub assembly or series of sub assembled these were identified by a "U" (*Untergruppe* or sub group) followed by numbers for each of the individual parts. If an "St" numbered drawing has a hyphened suffix this indicates the component has been redesigned, the numbers were consecutive and indicated how many design variation had been made. If a component was urgently required the drawing sent to

Opposite Page:
This series of photographs was taken on 16th March 1943 inside building M24, the final assembly hall, for Mr. Hehmann, one of the senior managers at the M·A·N Nürnberg plant to record the activity as series production of the Panther *Ausf.D* started to gather pace. There were six bays or halls making up the assembly line in this building. The *Wannen* and *Türme* would progress through the various work stations on rails set in to the floor. The bays all had several 3000kg overhead gantry cranes that moved up and down the bays on rails to assist with heavy components. A stock of the components required for each stage of the assembly process was stored next to each of the work stations. Some of the more complex items that were sourced by the *Heeres-Waffenamt* were kept in a bonded store which was manned by Wehrmacht store men. Specially fabricated platforms were used to ease access to the motor compartment. (Johann Buchner M·A·N)

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the assembly plant or sub contractor may not have been given a *Heeres-Waffenamt* number yet so that the drawing has a "Tu" prefix followed by a letter indicating the drawing size, this is an internal reference number used by M·A·N. A further set of numbers that might be generated for temporary drawings were those in the PV-G series that had a three digit suffix. These drawings generally referred to additional work required to be carried out on existing components to allow them to be used. An example of this would be the tow shackles bolts 48393-428 that were replaced with a new component in January 1945. A temporary drawing PV-G 595 was issued that covered the work required on the bolt so that it could be used on a new Panther and pass a *Heeres-Abnahmestelle* inspection.

On the Panther all parts relating to the new *Ausf.* D when it was introduced to series production started with 483, 502 was used for parts designed for the *Ausf.* A and 511 for the *Ausf.* G. When the design of a component was altered the new drawing/component number generated would be from the original series that the component was designed for. A good example of this is the *Kugelblende* ball mount which has the five digit suffix 48301 when introduced on the *Ausf.* A and kept this number when it was subsequently used on the new *Ausf.* G. The reason it has this number rather than 50201 is that this component originates from the *Wanne* design for the *Ausf.* D so starts with the number for this series 483. Another example of this is the "Chin" gun mantle introduced on the *Ausf.* G series production the component number for this part is 50258. The *Turm* design originates from *Ausf.* A series production so the new component has a number from this group. If we use the gun mantle fitted to Panther *Fgst.Nr.* 124932[2] at Aberdeen Proving Ground, Maryland in the U.S. as an example it has the number 021 A 50258-1 included in the casting. The five digit suffix and the group of digits after any hyphen were recorded on all major components for the *Heeres-Waffenamt* inspectors. These numbers would frequently be included in the mold for cast components either in full or an abbreviated form. This practice was more widespread on the cast components for the Tiger II *Ausf.* B than it was for the Panther, however they do appear on some parts such as the "Chin" gun mantle on Panther *Fgst.Nr.* 124932. The sub contractor might also include the date and the three letter manufacturer's identification code in the casting along with other information such as their mold or pattern number. It should be noted that the *Gruppen* numbers are not stock control numbers which might also be present on a casting or major component.

Modifications to the design were made at the direction of the *Heeres-Waffenamt* who would decide on the necessity of any proposed design change and whether it was to be accepted or not. These modifications were in response to requests from troops in the field or in the case of a change proposed by M·A·N who had design responsibility for the Panther series. These changes tended to be driven by improved performance or component availability. Any costs or savings involved would also be factored in to any decision and weighed against the benefits or disadvantages involved in accepting the design change. If the design change was accepted by the *Heeres-Waffenamt* they would then advise the assembly firms of the requirement for the design change and issue an amended contract to support this. In response the assembly firms would then advise the *Heeres-Waffenamt* of the possible dates for the introduction of the proposed change to completed vehicles. The *Heeres-Waffenamt* would then either accept or if appropriate advance the date of introduction of the design change if the timescale given by the assembly plants deemed this appropriate. The assembly firms would then comply; they would never query the date given by the *Heeres-Waffenamt* for the introduction of the design change which in most cases was fair. Any modifications to the design were simultaneously communicated to the assembly plants and the *Heeres-Waffenamt* inspectors with a duplicate set of drawings for inspection purposes showing any amendments or alterations to the design automatically being issued to the assembly plant or sub-contractor along with its resident *Heeres-Waffenamt* inspectors. This ensured that all of the design modifications scheduled for introduction by a particular assembly plant were communicated to that plant's *Heeres-Waffenamt* inspectors as well as the supervising staff and management from the assembly firms.

2 Panther *Fgst.Nr.* 124932 completed by Daimler-Benz on or about 16th November 1944.

Opposite Page:
The tracks have been installed on the Panther in the foreground; lengths of tracks and individual links are conveniently stacked to one side. There are also two of the circular motor covers that were bolted over the large central access aperture in the *Wanne* rear plate. A number of driver and radio operators' hatches can be seen lying to the right of the second Panther; two employees are busy assembling the internal spring mechanisms for these at the adjacent workbench. Some wag has chalked a cartoon style cat on the side armour of the Panther *Wanne* in the foreground. Panzer crews were frequently sent to the factory to assist with the final assembly stages of their Panthers. This would help them in the future as they benefited from the technical advice given by the experienced employees working alongside them. The Panzer crew working on the Maybach engine of the Panther in the foreground can be identified by their *Wehrmacht Feldmütze* caps. The motor comparment's hatch has the second pattern of ventilator covers which still had two protruding adjustment handles; these had been moved closer to the centre of the cover from the initial design. The tracks have been installed on the Panther in the foreground; lengths of tracks and individual links are conveniently stacked to one side. There were six bays or halls making up the assembly line in this building at the M·A·N Nürnberg plant. The *Wannen* and *Türme* would progress through the various work stations on rails set in to the floor. (Johann Buchner M·A·N)

The majority of design amendments were divided into three classes:

1. Those involving an alteration to a detail or component within the control of the assembly firm and which is not dependant upon an external subcontractor typically had a one month time allowance for its introduction to series production.

2. Alterations where the assembly firm was dependent on the delivery of components completed to the latest design standard from its external subcontractor.

3. Urgent alterations emanating from the *Heeres-Waffenamt* Inspectorate Headquarters in Berlin and in consequence passed through the *Heeres-Waffenamt* inspectors within the factory. As previously mentioned the military inspectors were considered the final authority at the assembly plants so that any modifications communicated through them that were not present on completed vehicles going through the *Heeres-Abnahmestelle* procedure within a reasonable but short timescale would result in the Panther's rejection.

The inspection procedure was split between the *Wanne* and *Turm* assemblies which were treated as separate components until they were brought together during the later stages of the Panther's assembly. The completed sub-component was run as a subassembly. This applied to major sub-components such as the both primary and final drives, motor, transmission, and the fully complete but unpainted *Turm*.

Wannen

Careful planning by M·A·N who had design responsibility for the series in conjunction with the component subcontractors and the assembly firms was essential to ensure that components could be installed and removed from the vehicles under the demanding conditions that the *Werkstatt* (repair shop) units frequently operated in. One example of this was the alignment of the drive train from the motor through to the gearbox and transmission. On the Panther no alignment check is required due to the use of Hooke's couplings which absorb any misalignment[3]. The incorporation of these and the use of the specially designed machine tools significantly reduced the need for time consuming and labour intensive alignment by the fabrication crew and significantly reduced the need for inspection of this installation on the Panther series. A series of extended test drives were completed by all new Panthers. This formed a contractual part of the *Heeres-Abnahmestelle* (delivery procedure) before any new vehicles were accepted for service with the *Wehrmacht*. This procedure called for Panther *Wanne* that were mechanically complete (these were called *Fahrgestell*) to be run for 15km to check the engine and transmission installation prior to mounting the *Turm*. The *Fahrgestell* was almost complete at this stage minus any sheet metal components that could be bolted on later. It was subjected to a 15km running test to ensure the power train, transmission and suspension system were all fully functional and there were no lubricant or cooling leaks to the satisfaction of the assembly firms' inspectors. A weight that simulated the *Turm* load was fitted for this test. This weight could easily be removed should any major component need to be removed or replaced. It was designed not to make contact with the machined surfaces on the *Turm* ring which reduced the potential for damaging any vulnerable internal components were the *Turm* to be fitted during this initial test.

3 These are also known as universal joints in the automotive industry.

Türme

The entire assembly of the *Turm* was conducted under the supervision of *Wehrmacht* personnel once the initial machining of the *Turm* had been completed on arrival at the assembly plant. It was assembled on a special cradle that replicated all of the power and drive connections within the *Fahrgestell*. This enabled the *Turm* to be fully tested as a complete assembly prior to its installation in the vehicle. The cradle could be mounted on castors which eased transportation around the assembly halls; however transportation was kept to a minimum to reduce the potential for damage to the vulnerable *Turm* basket assembly. The cradle incorporated the male *Turm* ring and race which would be transferred along with the *Turm* when this was being mounted on the Panther's *Fahrgestell*. The vehicle's 7.5cm Kw.K.42 L/70 gun was fully installed and its sighting carried out from this cradle. In one instance a tilting cradle was employed for checking the sighting equipment at various angles of tilt. It was the practice to use a special telescope for gun sighting manufactured by Carl Zeiss of Jena. This fitted into the breech of the gun and was laid on the target in exactly the same manner as the sighting telescope. The sighting was carried out by *Wehrmacht* personnel who tested for line of elevation which was recorded from full elevation to

Opposite Page:
A Daimler-Benz assembled Panther *Ausführung* D undergoing one of the examinations that formed part of the *Heeres-Abnahmestelle* procedure prior to its acceptance by the *Heeres-Waffenamt* inspectors for service with the Wehrmacht. There is only one Bosch headlight on the glacis plate indicating it would be completed between June and August 1943. The vehicle is still in red primer other than its running gear and the lower Fahrgestell sides which were given a coat or *Dunkelgelb* RAL 7028 prior to the running gear being fitted. Note the civilian licence plate has a IA area prefix indicating its issue in the Berlin area, this was required for all vehicles that had not been accepted for service with the Wehrmacht as they were still ostensibly the property of the assembly firms and treated as civilian vehicles. (Bundesarchiv 146-1969-107-58)

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full depression at 5° intervals with the target at 50m. They also tested the amount of play within the elevation and traversing gears as well as the resistance on the hand wheel needed to traverse the *Turm* when it was level. This particular series of tests was strictly enforced with standardisation of targets, conditions and distances in all of the assembly plants. All of the electrical and drive connections were tested along with all of the interior components at this point. A rudimentary test of the guns recuperator and its recoil was also conducted when the weapon had been installed despite the fact that this had been inspected and the gun being stamped by a *Heeres-Waffenamt* inspector prior to its dispatch from the sub-contractor. This method of testing the *Turm* as a complete assembly in its cradle prior to mounting it on the vehicle ensured that any fault discovered when fitting it to the *Fahrgestell* was due to the installation of the *Turm* ring and race into the female ring on the *Fahrgestell* roof. The *Turm* would be checked again once it had been installed where it would receive an elementary inspection of its traverse and elevation mechanisms to ensure nothing had been damaged or become dislodged as a further part of the *Heeres-Abnahmestelle* procedure.

The completed and tested *Turm* is fitted to the *Fahrgestell* at the assembly plant and the vehicle is then subjected to a 50 to 60km running test across country and on roads. This inspection was usually carried out by the assembly firm's inspectors under the supervision of the *Wehrmacht*. If any defects were noted during the test the vehicle would either return to the assembly plant to have the defect rectified or have the component replaced at the testing grounds if it were easily accessible. If no defects were noted then the vehicle was returned to the assembly plant to have the last sheet metal components bolted in place and receive a coat of paint according to the current standard in force at the time of its completion. The fully completed and painted vehicle is handed over to *Wehrmacht* inspectors for the final part of the *Heeres-Abnahmestelle* inspection. It would be driven for a further 6 to 8km on roads and 15km cross country as part of this final inspection. The *Turm* would have its traverse and gun elevation gears checked again to ensure that these had not been damaged during the installation but no further checks on the sighting equipment would be conducted as these had already been checked prior to the *Turm* installation. The vehicles free issue components would have been recorded as they were installed and these would be checked against the inventory from the *Heeres-Waffenamt* bonded store at the assembly plant and recorded in the *Lieferschein* document which would also be used administratively to transfer the appropriate funds to the assembly plant in payment for the vehicle. It is only at this point when the vehicle has been accepted for service with the *Wehrmacht* that the *Balkenkreuze* national markings would be applied to the vehicle as it was now deemed to be *Wehrmacht* property. The Panthers assembled by M·A·N from September 1943 on, had a white, stylised "A" roughly painted on the gun travel lock to indicate their acceptance by the *Abnahme* inspectors. Vehicles destined for evaluation or development elsewhere were all subject to exactly the same inspection procedures up to whatever point in their assembly they had reached prior to being allocated to the relevant testing or development organisation that would take delivery of them. They were not accepted for service with the *Wehrmacht* so the white "A" and *Balkenkreuze* national markings applied to *Wehrmacht* vehicles were not painted on them[4]. The *Heeres-Abnahmestelle* procedure was very tightly controlled using the "*Technische Lieferbedingungen*" or TL's (Technical Specifications for Delivery) and drawings issued to the inspectors for this purpose by the *Heeres-Waffenamt* which gave the acceptable finish and approved component list for each of the assembly plants.

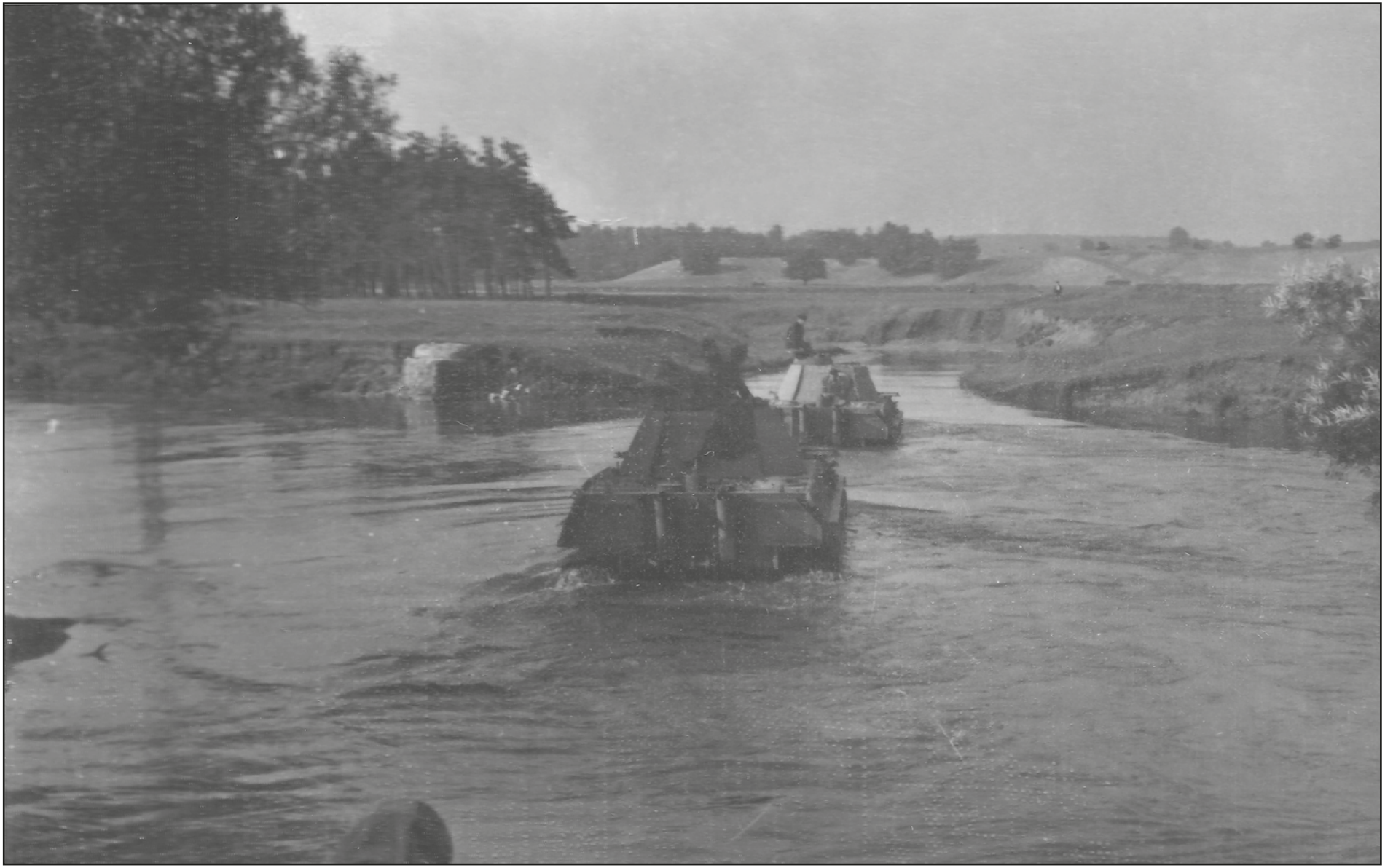
This quality control process was refined for the *Ausführung* A and G as a result of the lessons learned from series production of the *Ausf*. D. It was then vigorously enforced at the assembly plants right up to the end of the war. This included the vehicles paint finish; there is no evidence of vehicles being delivered to the troops with raw steel components or in plain red primer that was devoid of any secondary camouflage. Nor is there any evidence at all of new vehicles being completed with components taken from older vehicles. Any deviation from the inspectors list of acceptable components and finishes would require a specific exemption from the *Heeres-Waffenamt*. The meticulous examination of components during the *Heeres-Abnahmestelle* inspections and upon receipt of those items sourced directly by the *Wehrmacht* maintained the strict quality control process enforced at all of the assembly plants and their suppliers. This quality control process was equally enforced on the repair, refurbishment and conversion work undertaken by the armour repair workshops at the M·A·N plant in Nürnberg who were responsible for conducting repairs to the majority of Panthers returned from the front for "factory maintenance".

The assembly firms involved in armour production would be issued *Fahrgestell* numbers or *Fgst.Nr.* in blocks appropriate to the numbers of vehicles for a given production series they had been contracted to complete by the *Heeres-Waffenamt*. These numbers would be used to identify a particular vehicle throughout its life while

4 Allied reports on inspection procedures within the German armaments industry held at NARA and the Imperial War Museum.

Opposite Page:
The facilities at Hainberg were used extensively by M·A·N for the extended test drives that formed a part of the *Heeres-Abnahmestelle* procedure. Here we can see several Panther *Fahrgestell* fitted with the weights that were used to simulate the turret load when they underwent the first 15km test run. They are accompanied by two almost complete Panthers which are about to undergo the longer 50-60km cross country test run which would be followed by final assembly and the last stage of the inspection process that included a further 6-8km test drive prior to acceptance for service with the *Wehrmacht*. The *Fahrgestell* in the foreground has suffered a *Turmantrieb* (Turret drive assembly) failure during its initial 15km test drive, this is in the process of being repaired on the vehicles engine deck by the two M·A·N employees. (Johann Buchner M·A·N)

M·A·N employees assisted by one of the Panzer crews sent to assist with the assembly of the Panthers that would be allocated to his unit, check the tension on the road wheel hub bolts during the first 15km test drive that formed a part of the *Heeres-Abnahmestelle* procedure. The Panther *Fahrgestell* is fitted with the weight that was used to simulate the turret load when undergoing the first 15km test run. The *Fahrgestell* has been given a coat of *Zimmerit* paste and the running gear has been painted in *Dunkelgelb* RAL 7028. The upper surfaces of the Fahrgestell have still to be painted and are either in red primer or the ochre colour of the unpainted *Zimmerit*. The Panther will not be given its final coat of paint until the vehicle has successfully completed all three of the test drives from the *Heeres-Abnahmestelle procedure.* It is unusual for the sheet metal components such as the Schürzen rails to be fitted prior to the initial 15km test drive on M·A·N assembled Panthers. (Darren Gawle & Roddy Macdougall)



A column of *Ausführung* G Panthers fording the River Redntiz on the north eastern edge of the Hainberg training area. The centre vehicle can be identified as a *Pz.Bef. Wg.* Panther by the armoured pot for the *Antennenfuss* for the *Sternantenne D* mounted on the engine deck. Another two Panthers can be seen in the distance behind the person standing on the river bank. The presence of so many *Wehrmacht* personnel indicates that this is possibly the final 6-8km test drive at the end of the *Heeres-Abnahmestelle* procedure. Although the photograph has suffered from the effects of the last seventy plus years we have published it as there are so few privately taken photographs that document the *Heeres-Abnahmestelle* procedure. The Panthers appear to have a coat of *Zimmerit* paste on the vertical surfaces of the armour the upper surfaces have still to be painted and are either in red primer or the ochre colour of the unpainted *Zimmerit*. (Darren Gawle & Roddy Macdougall)

being assembled as well as after its issue to the *Wehrmacht*. Each vehicle would be treated as an individual project that would be allocated the next consecutive *Fahrgestell* number as its production commenced. If a vehicle was held back while remedial work was carried out the *Fahrgestell* number would not change.

The major armour components for each *Fahrgestell*, the *Wanne* and *Turm* would have their own 6 digit component numbers that are often confused with the *Fahrgestell* number. These numbers were also issued in blocks to the armour manufacturers by the *Heeres-Waffenamt* and allocated to the individual component by the armour manufacturer in exactly the same manner as the *Fahrgestell* numbers. These armour components were not manufactured in matched sets of *Wannen* and *Türme* though the purchase contracts would often, though not always, be for equal numbers of these components. To give an example of this it was possible for an assembly firm to complete a new Panther using a *Wanne* manufactured by Ruhrstahl Hattingen and a *Turm* manufactured by Eisenwerke Oberdonau.

This would seem to be an appropriate point to give a very brief overview of the general situation affecting Panther production in Germany between 1943 and 1945. Although Germany had been at war since 1939, its economy had not moved over to full war effort production until 1943-1944. Panther production reached a peak in the summer of 1944 with an average figure of 348 per month being accepted by the *Heeres-Waffenamt* between April and September 1944[5]. The situation steadily deteriorated as the Allies advanced across Europe and the bombing campaign against German Industry and resources gathered pace. The assembly plants were faced with shortages in material, labour, water and electricity all of which were essential to maintain productivity.

The loss of skilled labour to the *Wehrmacht* and a haphazard "nobody cared" attitude at the assembly plants has often been used in the past to explain away complex camouflage patterns and the evolution of these as new schemes were introduced, others discontinued and the failure to recognise this evolution for what it was. There were many factors that influenced the changing finish applied to Panthers leaving the assembly lines between 1943 and 1945 but a lack of care on the part of the employees was not amongst these. All of the evidence suggests that the manufacture of sub components and the assembly of these vehicles were undertaken with considerable skill and care right up to the end of the war. There were acceptable tolerances within the manufacturing and assembly process however, sub standard work was extremely rare and in any case would be rejected by the *Heeres-Waffenamt* inspectors during the *Heeres-Abnahmestelle* inspections or by the assembly firms own inspection team prior to the vehicle being accepted for service with the *Wehrmacht*.

M·A·N was contracted by the *Heeres-Waffenamt* to complete the work on Panthers returned to Germany for factory maintenance. They had dedicated facilities and staff at their Nürnberg plant that were used for major repairs and refurbishment of worn or battle damaged vehicles returned from the front. The numbers of remanufactured vehicles delivered to the *Heereszeugamt (HZA)* were very small with only 154 Panthers being reissued to the troops from 1943 to the end of the war. This was one of the few facilities with the expertise and equipment necessary to disassemble major components and rebuild them to the exacting standards imposed by the *Heeres-Waffenamt* inspectors. All of the vehicles refurbished by this facility would have been completed to the same high standards as the new vehicles leaving the assembly plants so that they are particularly difficult to identify in period photographs.

The absence of extremes is also relevant to *Werkstatt* units, there are very few photographs of Panthers with a component that can be identified as having originally come from a different vehicle or *Ausführung*, these do exist but they are extremely rare. "Frankenstein" or "Hybrid" Panthers assembled using parts from numerous vehicles and *Ausführung* are uncommon; the reality is that the engineering effort required to fit a major component such as the *Turm* from an *Ausf*. D to either an *Ausf*. A or *Ausf*. G exceeded the capability of the *Werkstatt* units. These "Field Conversions" or "Hybrids" may be considered "cool" in some circles but they have more to do with overdeveloped imaginations and poor research than any significant basis in reality.
There is some evidence that a third level of maintenance was operated by *Wa. J. Rü.*, photographic evidence exists of Panther *Wannen* returned from the front in jigs at the armour manufacturers. These *Wannen* have been completely stripped of all components and are in the process of having their armour plates either replaced or repaired. When the repairs were completed these *Wannen* would have been delivered to the assembly plants along with newly completed *Wannen*. When completed these would have been identical in appearance to other Panthers of the same *Ausführung* being completed at that time and would be issued a new *Fahrgestell* number. This is known to have occurred with other armoured vehicles where a new *Fahrgestell* number was stamped over the old one with a suffix to indicate that it had been extensively reworked[6].

5 Jentz and Doyle: *Panzer Tracts No.23 Panzer Production.*

6 Allied reports on inspection procedures and working practices with the German armaments industry held at NARA and the Imperial War Museum.

Opposite Page:
Following on from the photograph on page 25. A colleague has now arrived to assist with the repairs to the *Turmantrieb* (Turret drive assembly) The two almost complete vehicles have not yet received their final coat of paint which would be applied after the 50-60km test run. They all have had the vertical armour plates coated with an application of *Zimmerit* anti-magnetic paste and areas that would be inaccessible after the running gear was fitted was given a coat of paint in accordance with the assembly plants contract with the *Heeres-Waffenamt.* Most of the external sheet metal components were not bolted in place for the first two test runs due to the ease with which these could be damaged when traversing the rough terrain at the Hainberg facility. (Johann Buchner M·A·N)

Otto Nikolaus Klein

Otto Nikolaus Klein was born on 29th July 1914 in Nürnberg, the son of parents who moved from rural Franconia to Nürnberg attracted by the benefits of industrialisation. Mr. Klein was the first generation of his family born in an urban environment and the social turmoil of the First World War. After finishing general secondary school at 14 years old he started a four year apprenticeship as machine fitter at Maschinenfabrik Kayser in Nürnberg from 30th July 1928 to 29th July 1932. Despite the economic situation when he had completed his apprenticeship he managed to gain employment.In 1935 he started to work with M·A·N in Nürnberg, however after nine months with the company, he was drafted for military service. Due to his fitness, medium height (170cm) and technical skill he was selected for the new and very elite *Panzerwaffe*. He underwent military basic training followed by tank driver training at Ohrdruf/ Thuringia with 8./Pz.Rgt. 4 from 28th October 1935 to 3rd October 1936. His Regiment was then redeployed to Schweinfurt on the 4th October 1936, where Private First Class Klein finished his military service on 2nd October 1937. The unusually late discharge date was a result of Mussolini's visit to Germany at that particular time and tank drivers were required for the parades that formed part of the ceremonies for this event.

Following his military service he was reemployed by M·A·N at Nürnberg from 7th October 1937 when he started working as a machine fitter and driver. He officially worked in the truck section where he could enjoy the benefits of having a driver's licence which would see him transferring truck chassis all over Europe before the war. In those days M·A·N would sell bare chassis to other companies within Europe to be equipped by them with a cab and bodywork following delivery. The chassis were driven without regard to weather conditions with the driver sitting in the open on a wooden bench equipped with a leather pilot helmet, heavy leather coat and goggles to protect him from the elements.

His military training and driver's licence qualifications would see him selected to work as a driver with the "Off Road Vehicles" department who were responsible for the development and production of armoured vehicles. He would have the opportunity to drive various tank models at M·A·N where the development of the Panther series would become his main task from 1942 on. He explained that the tank testing was very straight forward. They would subject each part to an endurance test until it failed, e.g. tank tracks were driven through the rough terrain at Hainberg until the tracks or drivetrain failed and the data recorded. The engine was tested on the highway or testing area in a Panther fitted with special tracks and no *Turm* (turret). It would be driven at maximum speed until the engine would break down or catch fire. This type of testing need particularly skilful drivers as its purpose was to test the components endurance and suitability rather than how much abuse or misuse the component would endure. As Germany's war situation changed M·A·N would devote considerably more resources into the refurbishment and repair of tanks

Above:
Otto Nikolaus Klein during his service with 8./Pz.Rgt. 4, he would go on to work at M·A·N where he would become heavily involved in the testing and development of various tracked armoured vehicles. The Panther series would become his main task from 1942 on until the effects of the Allied air offensive significantly curtailed further development at the Nürnberg plant following which he led one of the crews conducting repairs on vehicles returned from the front lines for "factory Maintenance". (Oliver Fein)

Otto Nikolaus Klein at the controls of an early Panther *Fahrgestell* undergoing trails at Hainberg military training conducted on 12th March 1943. During tests the early series production Panther had shown a tendency for the tracks to climb over the drive sprocket as shown in this photograph. The *Turm* has been replaced with a specially designed sheet metal cabin mounted over the turret ring that was unique to Panthers undergoing development and testing at the M·A·N plant. (Johann Buchner M·A·N)

returned from the units at the front. A considerable amount of this type of specialised work had been undertaken by M·A·N at its Nürnberg facilities since the beginning of the war. As the size and complexity of tanks had increased, it was no longer possible for small workshops to undertake major repairs. Contracts for the repair of larger vehicles would be issued by the *Heeres-Waffenamt* to the specialised M·A·N repair facilities to carry out this work. When not involved in test and development work Mr. Klein was ordered to lead one of the tank repair teams. The repair of damaged tanks was very unpopular work as the vehicles returned from the front had often been on the railway for quite some time and the tanks were still contaminated with human remains. He described scenes where they found rotten legs, still in boots squeezed into corners of the interior or turrets sprayed with blood and brain tissue. There were facilities for decontaminating major components at the M·A·N plant however the task was still extremely unpleasant. Having completed their daytime shifts, M·A·N employees were also required to serve in the "*Luftschutz*" (anti aircraft home guard) or as *Blockwart* (air raid warden) and ultimately in the *Volkssturm* (home guard). Mr. Klein's extensive experience as a heavy machinery fitter and tank driver ensured he was retained as a defence industry employee at M·A·N almost to the end of the war.

When the US 7th Army arrived at the outskirts of Nürnberg the battle of Nürnberg began. This would last from 16th April to 20th April 1945. All available personnel including Mr. Klein were ordered to engage the American troops at Rechenberg south west of Nürnberg. They were poorly equipped with obsolete weapons; however the men drafted into the *Volkssturm* were still expected take part in the defence of Nürnberg despite the fact that the war was clearly lost.

Following the war Mr. Klein worked as a as machine fitter In the *Kraftwagenbetriebswerk* for the *Deutsche Reichsbahn* (German state railway) from 25th June 1945 to 31st May 1947. Following this he started working with the *Bundesbahn* (German state transport company) as an engine driver and became a civil servant. Following his early retirement in 1971 he died on 15th January 1993 in the Franconia region where he was born, lived and worked. He was heavily involved in the Panther Programme and would remain fascinated by this remarkable series of vehicles all of his life.

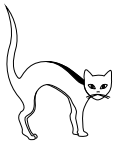
Above:
Panthers returned to the M·A·N plant in Nürnberg for factory maintenance sitting on Ssyms' 50ton flatcars in the plants railway yard. The overall number of Panthers repaired from 1943 to 1945 was relatively small, only 154 vehicles were reissued to the troops as combat vehicles. This does not include the significant number of early vehicles converted to Bergepanthers at Aschaffenburg by B. Seibert GmBH. (NARA via Darren Neely)

Opposte Page:
This photograph shows another aspect of test and development work on the Panther series that Mr. Klein was engaged in. The *Versuchs Fgst.Nr. V1* fitted with the running gear intended for use on the forthcoming Panther II undergoing a series of road tests on 29th June 1943. These were carried out on a road at the Märzfeld site1 which is south of the Nürnberg Zeppelin Field and was conveniently located within a few kilometres of the M·A·N factory. An undulating surface was fabricated from profiled timber beams to provide the desired height, length and gradient. The resonance tests were designed to examine how a series of specific peaks and troughs affected the design characteristics of the suspension components at varying speeds and the driver's control of the vehicle. (Johann Buchner M·A·N)

M·A·N had a dedicated tracked vehicle test and development facility at its Nürnberg plant. This facility was equipped with rolling roads and jigs that were capable of testing a vehicle's tracks and suspension units to the limits of their performance and beyond. It also had specially designed instruments to measure the loads and stresses imposed on the running gear and its individual components. A series of tests were conducted using a series production Panther Fahrgestell on 7th May 1943. The vehicle was fitted with a sheet metal cabin for the crew over the *Turm* (turret) ring. It has also had some extra equipment fitted including a timber platform mounted over the engine deck to allow the engineers to record data and a jib to allow a cine film of the test to be recorded. (Johann Buchner M·A·N)

Several of the initial *Ausführung* D Panthers were retained at the M·A·N factory as Mules for testing new features such as the ring mount for the *Fliegerbeschussgerät*, the rain guards over the pistol ports or the coating of *Zimmerit* anti magnetic paste applied to the *Fahrgestell*. This Panther undergoing tests at the M·A·N facilities at Hainberg has the testing rig and measuring instruments attached to the final drives and drive sprocket that were used on the Panther on the opposite page. These Panthers retained for test and evaluation purposes frequently have a black Panther logo stencilled on the *Turm* side. This should not be confused with the stalking Panther logo applied to Panthers from Pz.Abt. 51. There does not appear to be a muzzle brake fitted to the 7.5cm Kw.K.42 L/70 main armament. (Johann Buchner M·A·N)

3. PANTHER AUSFÜHRUNG D



We are fortunate that the majority of *Ausführung* D Panthers were issued to a small number of units most of whom fought in the East. The relatively few numbers of *Ausführung* D Panthers that served in the West were almost exclusively limited to those issued to training establishments. A very small number were issued to the Panzer Regiments engaged in the West, usually by a circuitous route via one of the aforementioned training establishments. The main assembly plants involved in production of the *Ausführung* D were Maschinenfabrik Augsburg-Nürnberg (M·A·N) at Nürnberg, Henschel und Sohn at Kassel, Maschinenfabrik Niedersachsen Hannover (M.N.H.) at Hannover Linden and Daimler-Benz at Berlin Marienfelde.

It could safely be said that the first *Ausführung* D Panthers were considered by some sections of the *Wehrmacht* to be a source of constant trouble. A lot has been written regarding its combat debut at Kursk with most accounts summing this up as a failure. The problems that were experienced were expected beforehand so that its combat performance was in reality very encouraging[1]. The speed with which the Panther *Ausf*. D was introduced into service was the main reason for the production series' largely unwarranted reputation for unreliability. The teething problems encountered were not unexpected, the dilemma was that insufficient time had been allowed to test and refine the design before it entered service with the *Panzerwaffe*. This resulted in numerous mechanical problems, with the transmission and final drives causing the most problems. There were also some problems with the fuel lines which were exacerbated by the lack of space resulting from use of the Maybach HL210 engine and the design constraints of including provision for deep wading[2]. The fact that the Panther was rushed into series production inevitably meant that teething problems that should have been ironed out during the development phase were still present when the vehicles were issued to the troops. Of the 174 vehicles completed by the assembly plants up to the end of April 1943 only 4 had been issued to the troops for training purposes. The rest were undergoing the remedial work necessary to make them *Kampf Versandbereit* (combat ready) prior to the troops taking them over. It would be fair to say that the *Ausführung* D could to all intents and purposes be considered a development series. It had entered production at the assembly plants in January and February 1943 but work had already started on its successor with meetings to discuss the Panther II being held in January and the next model that would enter series production, the *Ausf*. A, on 18th February 1943[3]. In spring and summer 1943 a tremendous amount of pressure was applied to the various organisations involved in the production, issue and use of the Panther to ensure that as many vehicles as possible were ready for the *Wehrmacht*'s major summer offensive code named *Unternehmen Zitadelle* (Operation Citadel). Arrangements were made to rectify the problems identified with the initial production run without interrupting series production of the vehicle. Completed vehicles that had already been transported to the *Heereszeugämter* at Sennelager and Altengrabow would be sent to the engineering firm Demag at Berlin Albrechtshof who would carry out the modifications to these Panthers. Meanwhile the assembly firms involved in series production would implement the modifications needed to correct the faults identified on Panthers already completed but not issued. Those Panthers already accepted and transported to the *Heereszeugamt* and "*Panzer-Lehrgänge Panther*" at Grafenwöhr, irrespective of which assembly firm had completed them, would have the remedial work carried out by repair crews from the M·A·N plant in Nürnberg. The training area at Grafenwöhr had extensive space and facilities so rather than ship these Panthers elsewhere arrangements were made to complete the remedial work at the *Panzer Kaserne* vehicle sheds and workshops. This remedial work was regulated by Major Egon Streit who was the "*Kommandeur der Panzer-Lehrgänge Panther"* (commander of Panther tank training) when this work was carried out in summer 1943.

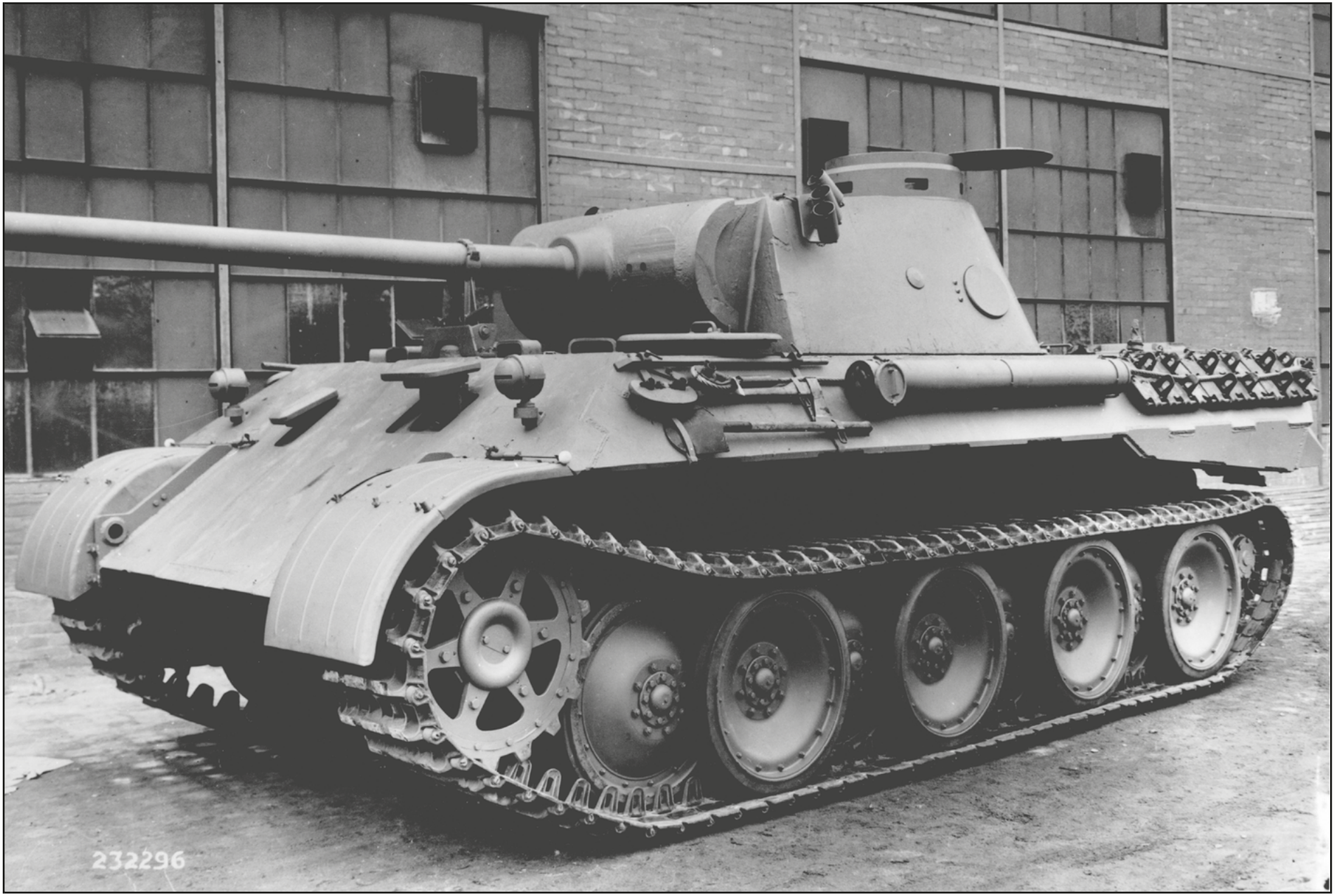
During the course of this remedial work, several groups of the vehicles being worked on were, where possible, brought up to the latest design standard. The identification of the original assembly plant and the date of completion for any *Ausführung* D Panther is further complicated by the fact that a significant number of the Panthers originally assembled by M.N.H., Daimler-Benz or Henschel had remedial work carried out by either Demag or M·A·N prior to being issued to the troops. This has resulted in large groups of vehicles that have no visible *Fgst.Nr.* where it is almost impossible to accurately identify the date of original completion as they have features that were introduced by the assembly firms both before and after they were accepted for delivery by the *Heeres-Waffenamt*. However, there are several build features that can be used to help identify the approximate date of completion or the assembly firm that completed a Panther.

At the start of the war, all Panzers were painted in a two-tone scheme of *Dunkelgrau* (dark grey) and *Dunkelbraun* (dark brown). *Dunkelgrau* RAL 46 (later renumbered RAL 7021) was the base coat. Irregularly shaped patches of *Dunkelbraun* RAL 45 (later renumbered RAL 7017) were to be spray painted on to one third of the surface. In June 1940, a general order was issued to stop applying the patches of *Dunkelbraun* and to use only *Dunkelgrau* RAL 46 for the entire surface. This was still the case when the Panther entered series production in December 1942.

1 Friedli: *Repairing the Panzers. Volume 2*.

2 Maybach had design responsibility for the motor and engine compartment within the dimensions dictated by the *Heeres-Waffenamt* contract.

3 Jentz and Doyle: *Germany's Panther Tank, The Quest for Combat Supremacy*.



One of the first series production Panther *Ausführung* D completed by M·A·N outside the main assembly hall at the firms Nürnberg plant. The first eight or so vehicles were finished in *Dunkelgrau* RAL 46, this was the standard colour for *Wehrmacht* vehicles at that time. The road wheels are the 16 rim bolt design, these would prove to be unsuitable and the design was eventually revised to have 24 rim bolts. The original tool stowage brackets on the port side had provision for the smaller towing clevis and the axe was stowed with its head at the rear of the bracket. The gun cleaning tools tubes on the initial vehicles had three mounting brackets , this design was quickly revised so that the centre bracket was deleted. (Johann Buchner via Bundeswehr WTS)

The design specification for production series had evolved as a result of the test and development work carried out by the M·A·N design team at Nürnberg and at the Hainberg testing area which was only 11km away from the M·A·N plant in Nürnberg. The design of the *Kettenantriebsrad* (drive sprocket) used for the Panther *Versuchsfahrgestell* was refined so that the 6 spokes on the main casting had a solid cross section. This variation would only be used by M·A·N on around the first ten vehicles[4]. All of the other assembly plants would fit a further variation of this design which would become the standard design for all of the Panthers produced by all of the assembly plants but with the toothed ring secured by 32 bolts with castellated nuts[5].

December 1942

Two methods for interlocking wedge shaped pannier the second model having smooth plates cut parallel to both faces only seen on *Wannen* produced by Ruhrstahl Hattingen (bwx).

February 1943

In February 1943, a general order was issued to change the base coat from *Dunkelgrau* to *Dunkelgelb nach Muster* (later numbered RAL 7028) a tan colour. Field units were to be issued tins of *Rotbraun* RAL 8017 (red brown) and *Olivgrün* RAL 6003 (dark olive green) paste concentrate which could be mixed with a suitable diluting agent to create camouflage patterns that are suitable for local conditions. The 7.5cm Kw.K.42 L/70 main gun was designed and manufactured by Rheinmetall-Borsig AG who delivered completed guns to the assembly plants in heat proof lacquer paint. This lacquer was either *Dunkelgelb* RAL 7028 or a dark grey colour; all of the assembly plants would deliver completed Panthers with the gun still in the dark grey lacquer. The commander's hatch on cupolas from the first production series pivoted from a centre point on the *Turm* rear quarter rather than its side. The commander's hatch changed so that the pivot point is at 90° on the port side off the cupola's centre line. This afforded easier access to the operating mechanism for the commander; this was now immediately to his left when he was seated whereas in the original design it was behind his left shoulder.

4 Panther *Fgst.Nr.* 210008 has this early *Kettenantriebsrad* (drive sprocket) design variation, while Panther *Fgst.Nr.* 210011 has the standard design with 32 rim bolts with castellated nuts.

5 A new design of *Kettenantriebsrad* (021 B 48395-1) with a cast armoured *Deckel* (021 B 48395-3) is associated with a small number of Jagdpanthers completed in 1945 and an Ausführung D Fahrgestell equipped for testing found at Nürnberg. A redesigned *Deckel* with 5 spokes rather than 6 was photographed fitted to a number of *Ausf.* F *Wannen* on the Daimler-Benz assembly line when this was overrun by Soviet forces at the end of the war. Neither of these *Kettenantriebsräder* were fitted to complete series production Panthers.

April 1943

When a larger towing clevis was introduced to series production in April 1943, Daimler-Benz and Henschel (Panther Fgst.Nr. 212017) used an interim stowage tool pattern where it was mounted vertically on larger pegs welded to sheet metal strips added to the original pattern tool stowage bracket. The other assembly plants fitted a revised design of tool stowage brackets to accommodate the larger towing clevis. At the same time the axe stowage was reversed so that the head now faced the front on the port side bracket. The new bracket was welded directly to the *Wanne* armour plate face rather than the sponson and *Wanne* roof as was the case with the earlier design. Sheet metal panels were mounted on the inside face of the *Gepäckkasten* (stowage boxes) to provide an element of protection to these from the intense heat generated by the Panther's exhaust system. Sheet metal plates known as *Schürzen* were introduced to enhance the level of protection to the lower *Wanne* sides from Soviet anti-tank weapons. The *Panzerkommission* had been concerned about the level of armour protection provided in the original Panther design and had already started to develop a new vehicle design which was originally designated the Panther 2 and the introduction of *Schürzen* was seen as an interim measure to help alleviate the problem until the new design would be ready for series production. *Schürzen* proved to be an effective solution to the problem and was a factor in the cancellation in early May 1943 of the new design which had been redesignated the Panther II. M·A·N start completing Panthers with rain channels over the loader's hatch and *Verständigungsöffnung* communications port, they would also start completing Panthers with rain channels over the pistol ports in the *Turm* sides and rear plate towards the end of April or the beginning of May. The other assembly plants would start delivering Panthers with these fitted in May though these would not be officially introduced until June. The initial external gun travel lock base was almost symetrical and had a securing pin on the starboard side brace thast prevented the hinged section from bouncing when in its stowed position. The design was changed in April to move the brace further out from the armoured ventilator cover that was underneath this component.

May 1943

In early May 1943 the Maybach HL210 motor was replaced by the Maybach HL230 P30. The air intake aperture on the engine deck was moved slightly further forward to accommodate the new engine. This was done at around the same time as the assembly plants started to complete a number of Panthers with an armoured cover over the air intake on the engine deck. However, this modification would not be present on all of the new vehicles completed and accepted for service by the *Heeres-Waffenamt*. The armoured cover was designed to protect a *Schnorchel* system that provided air to the carburettors when the vehicle was rigged for deep wading operations. The armoured cover for the *Schnorchel* would only be installed on a relatively small number of the Panthers completed after its introduction. The

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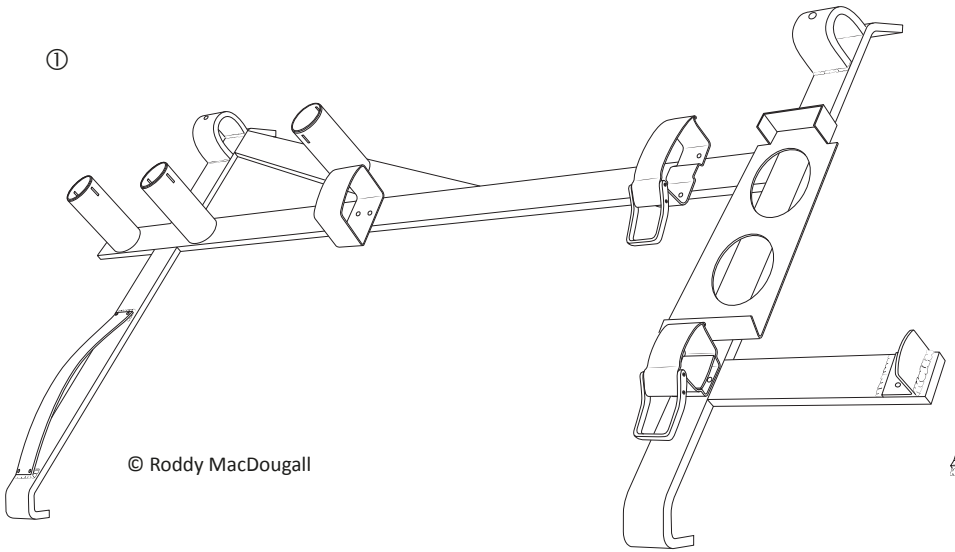

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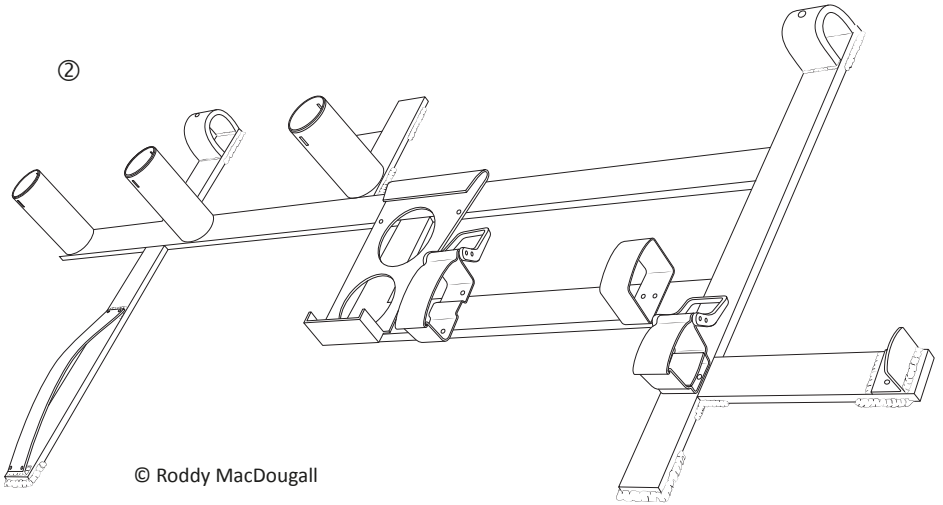

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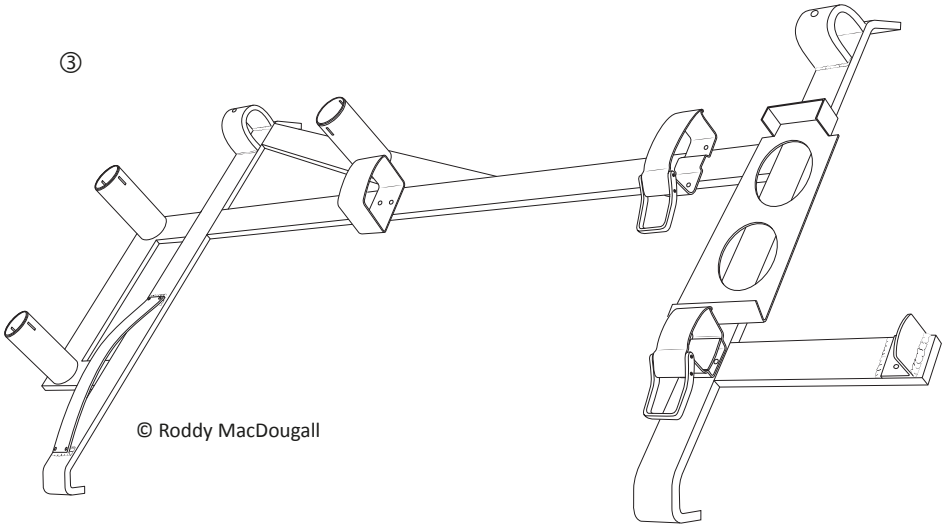
Ausführung D Tool Stowage Brackets

① The steel stock used to fabricate the original tool brackets fitted to series production Panther were extended to form straps that were welded to the *Wanne* roof and sponson floor. This was intended to alleviate any problems that might be caused if the tool brackets were welded directly on to the face hardened armour plate surface of the *Wanne* sides.

② A larger towing clevis was introduced to series production in April 1943, which coincided with a revised design for the tool stowage brackets. The new design eliminated the extensions so that it was welded directly to the face hardened armour plate surface. At the same time the axe stowage was reversed so that the head now faced the front on the port side bracket. The new bracket was welded directly to the *Wanne* armour plate face rather than the sponson and Wanne roof as was the case with the earlier design.

③ Daimler-Benz and Henschel are known to have use a modified version of the original pattern of bracket as an interim solution on a number of vehicles completed in April 1943. The new towing clevis was mounted vertically on larger pegs welded to additional steel strips. These were grafted to the original port and starboard brackets until a stock of the new components was available.

③



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These two photographs show Panthers undergoing remedial work under the *Kampf Versandbereit* (combat ready) programme at Grafenwöhr. This Panther is fitted with the intermediate modified tool stowage bracket that was used by Daimler-Benz and Henschel until stocks of the redesigned brackets became available. The new towing clevis was mounted vertically on larger pegs welded to sheet metal strips added to the original pattern of tool stowage bracket. This Panther has the initial design of gun cleaning tools stowage tube that was fixed to the hull side using three brackets rather than two found on later *Ausführung* D Panthers. This component would undergo further changes as the design evolved. The Nebelwurfgerät (smoke grenade launchers) have been removed from the Turm of the Panther on this page but are still present on the Panther photographed on the opposite page. (Johann Buchner M·A·N)

This Panther has the new larger towing clevis and the redesigned tool stowage brackets associated with this. Although there is no *Fgst.Nr.* visible, it is almost certain given the design features present that this Panther was completed in May 1943 and was amongst the first group of Panthers to be worked on. The stowage brackets for the spare tracks have been removed to allow the repair crews to remove the armour plate panels and castings on the engine deck so that they can access the radiators and cooling system. The Driver and Radio Operators roof plate and its associated components is being examined by Mr. Geiwitz, the head of design for off road vehicles at M·A·N in Nürnberg, along with one of his staff. Note the spring loaded end caps on the gun cleaning tools tube secured the caps to the tube so that these were not lost. However, the springs were easily damaged and these would later be replaced with latches and short chains to secure the cap to the tube. (Johann Buchner M·A·N)

starboard side tool stowage bracket received a further revision when the method of securing the jack block was changed from rods that were positioned diagonally across the bracket to a single hinged retaining bar. Henschel would complete a number of Panthers without a fire extinguisher fitted to the starboard tool stowage bracket from May to June 1943. An additional set of tool stowage brackets for the sledgehammer and track tensioning tool would be fitted to the starboard side of the *Wanne*, some earlier vehicles would have this fitted during the remedial work that was carried out on the early production vehicles.

Repair crews from M·A·N would also fit a sheet metal stowage box to the starboard side of a number of Panthers, irrespective of the original assembly firm, undergoing repairs at Grafenwöhr in an effort to address the lack of adequate stowage on the early production vehicles. This was originally thought to have been specific to Pz.Abt.51 and Pz.Abt.52, which in some respects it is as almost all of the vehicles with this modification were issued to these two units prior to the Kursk offensive in July 1943. A modified design was introduced for the fender extension mountings on the *Wanne* which would run concurrently with the original design[6].The mounting points were relocated to a slightly higher position on the lower *Wanne* side extensions and the fenders to suit the design modification. This design variation can be seen on some vehicles completed by all of the assembly plants up to their changeover to *Ausführung* G production. There is insufficient information to explain why this variation was introduced or why it did not completely replace the original design. It required the assembly firms to weld the mounting blocks in two different locations as well as ensure an adequate supply of both fender extension types which were not compatible with each other.

June 1943

Those units operating the Panthers that had been issued to the troops reported a high number of failures of the bolts fixing the rims that in turn secured the rubber tyres to the road wheels. As an interim measure the existing stock of road wheels were reinforced so that they were fitted with 8 sets of 3 rim bolts, 32 evenly spaced rim bolts, 16 flat head rim screws or 16 rivets along with 16 rim bolts. These modified wheels started to appear on completed Panthers in June 1943. This modification was also implemented by repair crews and *Werkstatt* units on some earlier vehicles. The *Nebelwurfgerät* smoke grenade dischargers were no longer fitted to the *Turm* in response to complaints from the troops operating other vehicle types that were fitted with them that hits from small arms fire would cause them to ignite, temporarily incapacitating the crew. A retaining catch for the loader's hatch was introduced in June and was back fitted on vehicles undergoing remedial work. The installation of sheet metal rain channels over the *Verständigungsöffnung* communications port, gun sight aperture and loader's hatch was officially introduced, the assembly plants had already started to implement this design change from late April to May[7]. The rain guards over the pistol ports in the *Turm* sides and rear were now dropped as they cast a pronounced shadow clearly indicating the location of the aperture. A ring for the *Fliegerbeschussgerät*, a bump stop for the hatch, a sighting vane and drain holes in the commander's cupola were all present on completed Panthers in June[8]. Instructions were issued to the assembly plants to ensure that the weld seam went all the way round the new stop introduced for the gun mantle on the top of the trunnion casting. This set of modifications was frequently back fitted to older vehicles by the repair crews or unit *Werkstatt* personnel. At the end of June 1943 the assembly plants started to complete Panthers without the *Verständigungsöffnung* (communications port) on the port side of the *Turm*. The implementation of this design modification was driven by the delivery of *Türme* from the armour manufacturers that did not have the aperture for the *Verständigungsöffnung* flame cut in the *Türme* sides.

July and August 1943

The second Bosch headlamp on the starboard side of the glacis plate was dropped along with the armoured cover for the *Schnorchel* in June so that theoretically the last vehicles with these features were completed in July 1943. However, the armoured cover for the *Schnorchel* would still be fitted to a small number of vehicles up to the end of *Ausführung* D production as well as a number of *Ausführung* A Panthers assembled by Demag. The last two modifications officially introduced to *Ausführung* D series production in August 1943 were modified Kgs64/660/150 caterpillar tracks which had 6 *Gleitschutzpickeln* chevrons on the grouser face and road wheels with 24 rim bolts. There is no evidence that any series production *Ausführung* D Panthers were fitted with the new tracks at the assembly plants. There were sufficient stocks at the assembly plants to enable the older design of tracks to be fitted for some weeks after series production of the *Ausführung* A had commenced. Armoured vehicle tracks wear out like tyres on a truck or car so that there are photographs of Panthers in service that have been fitted with the new tracks when the original set have worn out. A significant number of vehicles were still being delivered to the troops in August where some or all of the modifications that the *Heeres-Waffenamt* had instructed be made to the Panthers' *Türme* were missing. This had been a recurring problem and would result in the tightening of the acceptance criteria and its vigorous enforcement by the *Heeres-Waffenamt* inspectors during the *Heeres-Abnahmestelle* inspections. This would ensure that all of the Panthers accepted for service from the beginning of *Ausführung* A series production on fully complied with

6 This design modification is present on Panther *Fgst. Nr.* 213075 completed by Henschel in May 1943. See: MacDougall and Neely: *Nürnberg's Panzer Factory.*

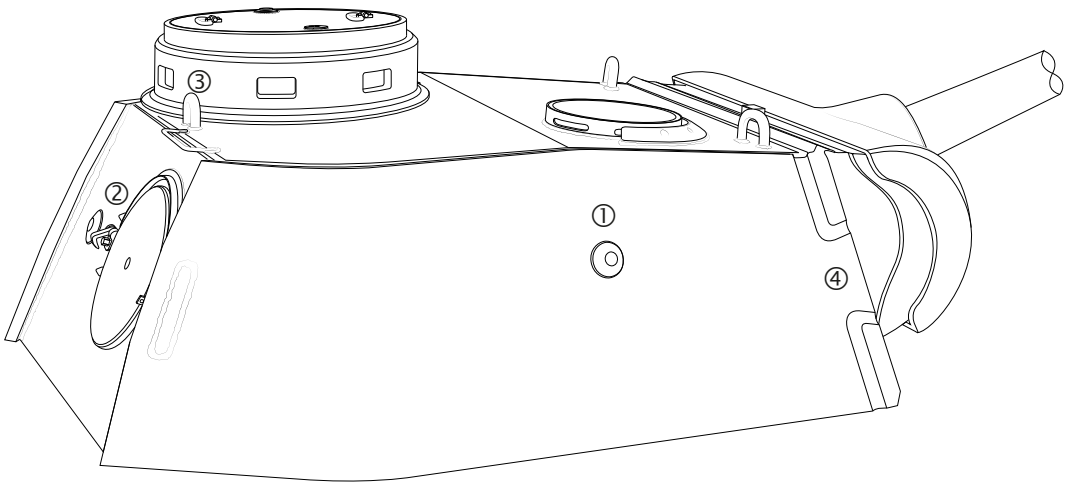
7 Panther *Fgst.Nr.* 210055 completed by M·A·N in May, Panther *Fgst.Nr.* 213061 completed by Henschel in May, Panther *Fgst.Nr.* 211035 completed by Daimler-Benz in late April and Panther *Fgst.Nr.* 213061 completed by Henschel all have these rain guards fitted.

8 These modifications would not be officially introduced for some weeks but were present on Panthers undergoing remedial work at Grafenwöhr in July 1943. See: MacDougall and Neely: *Nürnberg's Panzer Factory.*

Panther Fgst.Nr. 210111 completed in early June 1943 was the first vehicle put through the *Kampf Versandbereit* (combat ready) programme at the M·A·N plant in Nürnberg. This programme was intended to rectify the minor teething problems experienced by the design's very short gestation period from the drawing board to series production. A small ceremony was organised to mark this event where some of the plants management posed with the vehicle along with Hauptmann Klauder the senior *Abnahmestelle* inspector at the plant. Note the separate fender extensions which have been stowed over the top of the fenders fitted to the vehicle. (Johann Buchner M·A·N)

Ausführung D *Turm* (Turret)

The *Ausführung* D *Turm* completed at the end of May and early June 1943 no longer had rain guards fitted over the pistol ports in the rear plate and side armour as they cast a pronounced shadow clearly indicating the location of the aperture. ① The *Nebelwurfgerät* (smoke grenade dischargers) were deleted in response to complaints from the troops operating other vehicle types that were fitted with them that hits from small arms fire would cause them to ignite, temporarily incapacitating the crew. ② A retaining catch for the loader's hatch was introduced in June and was back fitted on vehicles undergoing remedial work. The installation of sheet metal rain channels over the *Verständigungsöffnung* (communications port), gun sight aperture and loader's hatch was officially introduced, the assembly plants had already started to implement this design change from late April to May 1943. ③ A number of the early *Türme* had the rear lifting point welded so that it ran fore and aft, this design variation was very short lived and the standard arrangement shown was used up to the end of *Ausführung* G production. ④The welded interlocks for the front plate Trunnion armour casting were dovetailed on the *Ausführung* D, when the design of this casting was changed for the *Ausführung* A Panther there was a transition period where a small number of *Türme* were manufactured with dovetailed interlocks rather than the parallel interlocks used on all subsequent *Türme*.



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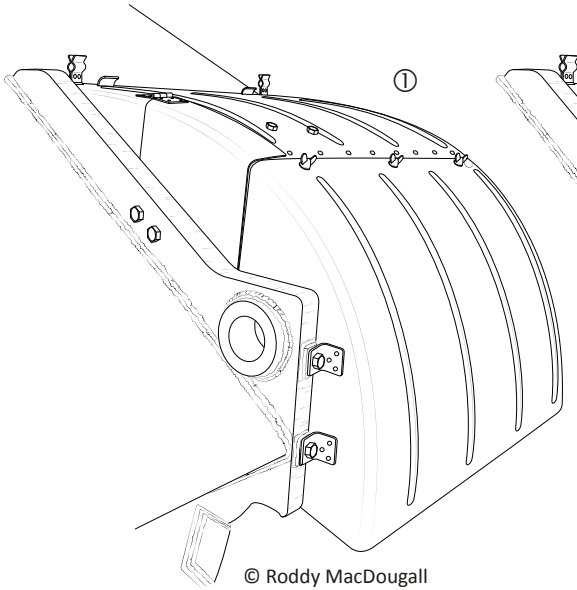
Fender Extension Mountings

A modified design ① was introduced for the fender extension mountings on the Wanne which would run concurrently with the original design ②. The mounting points were relocated to a slightly higher position on the lower Wanne side extensions and the fenders to suit the design modification. This design variation can be seen on some vehicles completed by all of the assembly plants up to their changeover to *Ausführung* G production. There is insufficient information to explain why this variation was introduced or why it did not completely replace the original design.



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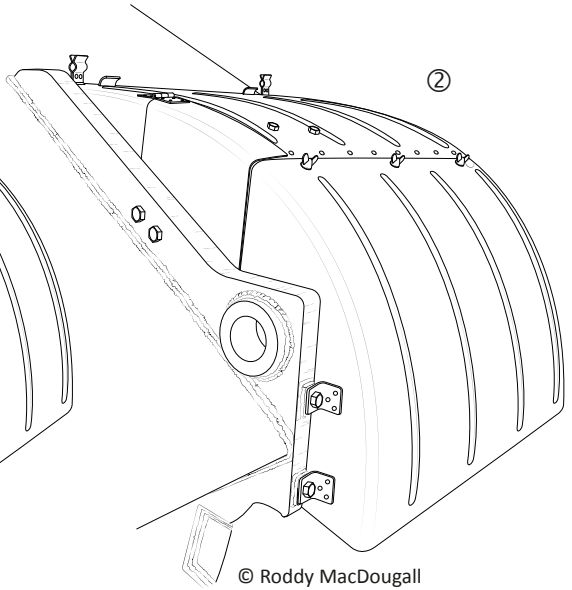

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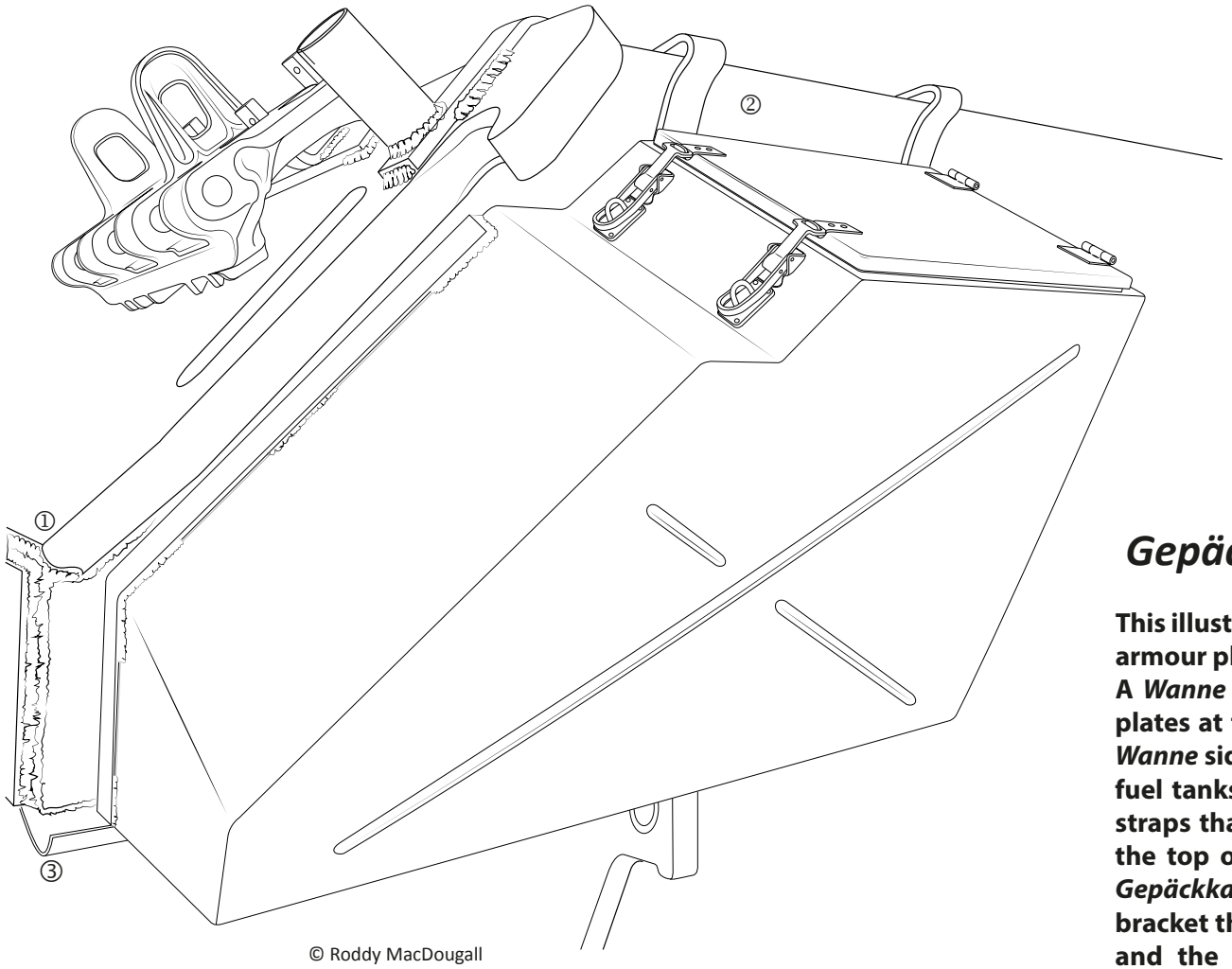

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Gepäckkasten (Stowage Boxes)

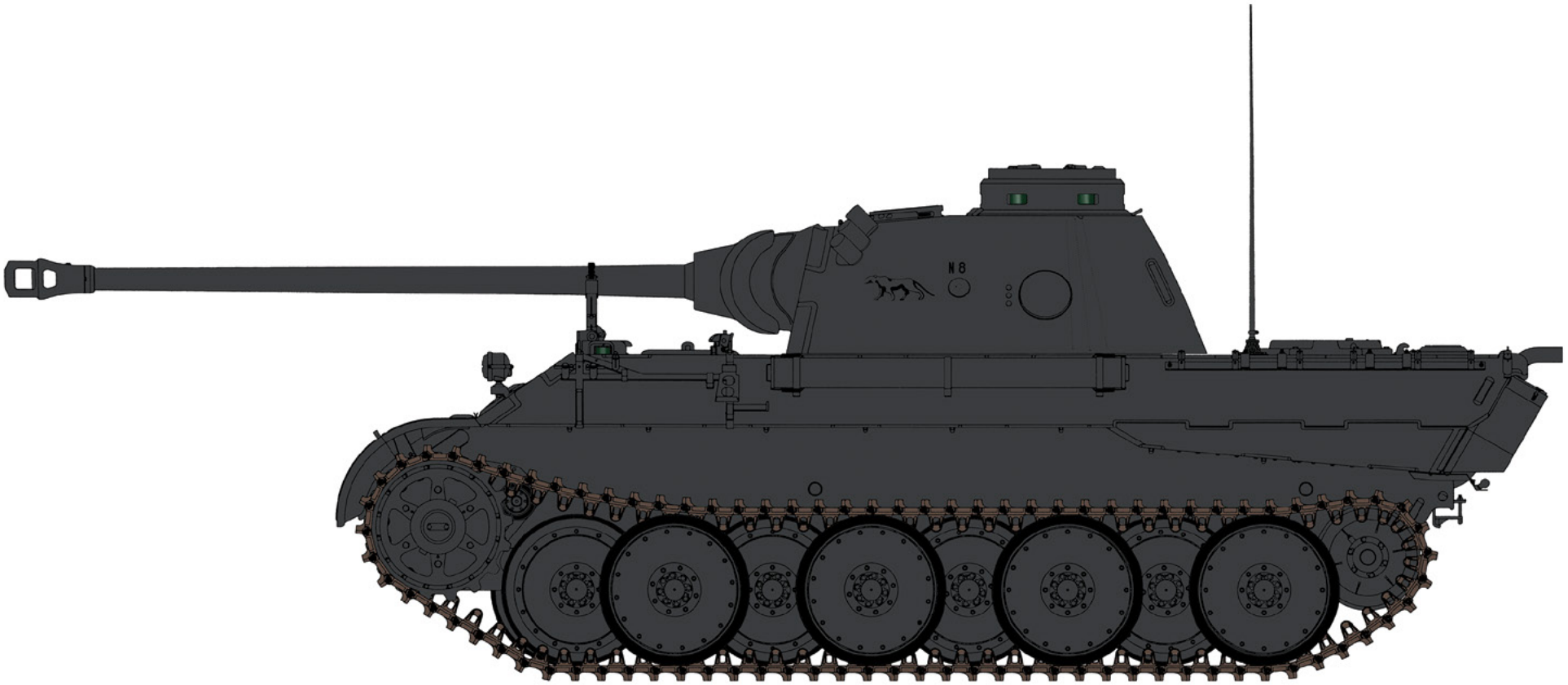
This illustration shows the general arrangement for the armour plates around the rear of the *Ausführung* D and A *Wanne* as well as the *Gepäckkasten*. ① The armour plates at the rear of the hull includes an extension on *Wanne* side and sponson to accommodate the vehicle's fuel tanks. ② The *Gepäckkasten* were fixed with steel straps that formed part of its frame that hooked over the top of the rear armour plate. The bottom of the *Gepäckkasten* was held in place by a ③ sheet metal bracket that bolted to the sponson floor on the *Wanne* and the *Gepäckkasten* frame. In order to limit the number of components that were welded to the face hardened surfaces of the armour plate, the brackets for carrying the lengths of spare track on the *Wanne* sides were hung on steel straps that bolted onto the engine deck. This method of fabrication was used by all of the plants involved in assembly of the Panther *Ausführung* D and A.

Panther *Fgst.Nr.* 210011 during the tests conducted at Hainberg with the first Bergepanther *Fgst.Nr*. 212161 assembled by Henschel as dedicated Bergepanther in late 1943. The Panther had received several upgrades in the meantime amongst which were the new pattern of drive sprockets, a ring for *Fliegerbeschussgerät* (M.G.34 anti aircraft mount) and a bump stop for the hatch on the commander's cupola. The only markings visible are the last two digits of the vehicles *Fahrgestell* number painted just ahead of the tool stowage brackets on the *Wanne*, this was repeated with an "N" prefi x on the *Turm* side just above the pistol port. Note the initial design for the tool stowage brackets and the gun cleaning tools tube with three mounting brackets rather than the two used on later designs for this component. (Johann Buchner M·A·N)

This was one of the last Panther *Ausführung* D completed by M.N.H. on or about 19th August 1943. The *Fgst.Nr.* 213208 is stencilled on the glacis plate and can be seen on the original print. It has most of the last design modifications introduced for the *Ausführung* D including a ring for the *Fliegerbeschussgerät* (anti aircraft mount for an MG.34), single Bosch headlight on the glacis and the revised tool stowage brackets, however the brackets for the 5kg hammer and track tensioning tool have been lost. The *Wanne* was manufactured by Ruhrstahl Hattingen and has the interlocking wedge shaped pannier for the fuel tanks at the rear of the vehicle has smooth plates cut parallel to both faces only seen on *Wannen* produced by this company. It has no Zimmerit and was finished in an overall coat of RAL 7028 *Dunkelgelb* paint. This vehicle is at the firing ranges at Grafenwöhr just prior to it being expended as a range target by 11th and 12th tank companies from the U.S. 1st Infantry Division who were using the firing ranges at Grafenwöhr in June 1948.. (NARA via Darren Neely)

Panther *Fgst.Nr.* 211213 was one of the last *Ausführung* D to be completed by Daimler-Benz on or about 8th August 1943 prior to commencing assembly of the new *Ausführung* A with deliveries of the new series scheduled fo commence in September. It has all of the design modifications present on the last *Ausführung* D including a ring for the *Fliegerbeschussgerät* (M.G.34 anti aircraft mount) on the commanders cupola, single Bosch headlight on the Glacis plate and the revised tool stowage brackets that include new stowage arrangements for the 5kg hammer and track tensioning tool on the starboard side of the *Fahrgestell*. This Panther was issued to *I./Pz.Rgt. 11* and was photographed during manoeuvres at the Sagan *Kaserne* in Silesia. The vehicles *Fgst.Nr.* can bee seen stencilled in white on the port fender extension. The original pattern of Kgs64/660/150 caterpillar tracks without the 6 *Gleitschutzpickeln* chevrons on the grouser faces were still being fitted to *Ausführung* D Panthers when production of this series was discontinued. (The Tank Museum Bovinton 6154-F6)

M·A·N Panther *Ausführung* D *Fgst.Nr*. 210008- early February 1943



Scale Drawings © Panzer Tracts 2016 Colour Artwork© Roddy MacDougall 2016

One of the early Panther *Ausführung* D completed by M·A·N in early February 1943. All *Wehrmacht* vehicles were finished in an overall coat of *Dunkelgrau* RAL 46 paint from the instruction "*O.K.H. (Ch H Rüst u. BdE), 31.7.1940 - 72/88/16 - AHA/In 2(VIII): Nr. 864 in Allgemeine Heeresmitteilungen, 7. Jahrgang, Blatt 18 vom 7. August 1940*". This would be changed to an overall coat of *Dunkelgrau* RAL 46 to *Dunkelgelb nach Muster* when the following order was issued "*O.K.H. (Ch H Rüst u. BdE), 3.2.1943 - 72d50/54 - In 2(IId): Nr. 181 in Allgemeine Heeresmitteilungen, 10. Jahrgang, 5. Ausgabe vom 22. Februar 1943*". The only markings visible is the last digit of the vehicle's *Fahrgestell* number with an "N" prefix on the Turm side just above the pistol port. It was common practice at the M·A·N plant to mark the exterior with either the full *Fahrgestell* number or the last two digits of this. As this was one of the first 9 Panthers completed the first digit would be a 0 so this has been omitted. It was fitted with the original pattern of tool stowage brackets and has the early design of road wheel where the rims were secured with 16 bolts. Very few if any of the early Panthers were issued to units that would serve at the front. The majority would either be used for testing and development work. Some would eventually make their way either to the *Panzer-Lehrgänge Panther* (Panther training course) or one of the *Pz.Ers.u.Ausb.Abt.* (Panzer crew training and replacement units). Most of them would be put through the *Kampf Versandbereit* programme implemented by M·A·N and Demag intended to resolve some of the initial teething problems encountered with the early *Ausführung* D. A stalking Panther logo was stencilled on a small number of the initial Panthers at the Nürnberg plant, This logo should not be confused with a similar logo that was used by Pz.Abt. 51 and Pz.Abt. 52 and applied after the Panthers were delivered to these units.

4. PANZERBEFEHLSWAGEN PANTHER

The very small numbers of *Ausführung* D Panthers issued to the Panzer Regiments serving in the West were predominately *Sd.Kfz.* 267 or *Sd.Kfz.* 268 *Panzerbefehlswagen* or Pz.Bef.Wg. Panther (Panther command tank). These vehicles were standard Panther tanks, which were modified with the addition of the radio equipment and associated GG400 generator, antennas, transformers, brackets and wiring needed for it to fulfil its command function by M·A·N at Nürnberg. M·A·N was the only firm contracted to supply these vehicles throughout series production of the Panther *Ausführung* D, A and G.

The designation *Sd.Kfz.* 267 or *Sd.Kfz.* 268 for a Pz.Bef.Wg. Panther was dependent on the task the vehicle was expected to perform and the radios fitted as a result of this. All *Sd.Kfz.* 171 Panthers, *Sd.Kfz.* 267 and *Sd.Kfz.* 268 Pz.Bef.Wg. were fitted with a FuG 5 radio set, the *Sd.Kfz.* 171 had this mounted just above the *Lenkgetriebe* (transmission) so that the *Funker* (radio operator) could control this from the starboard side of the *Fahrgestell*. A company commander or platoon leader's *Sd.Kfz.* 171 Panther could be fitted with both a FuG 5 and a FuG 2 radio set in this location. The *Sd.Kfz.* 267 and *Sd.Kfz.* 268 had the FuG 5 radio mounted on the starboard side of the *Turm* to allow the space in the *Fahrgestell* to be used for the more powerful radio sets fitted to these vehicles[1]. The transformers needed to operate the FuG 5 radio set in the *Turm* were installed in the space usually occupied by the coaxial MG.34 machine gun; the external aperture in the gun mantle for this was therefore sealed with an armoured plug. A 2.0m *Stabantenne* was fitted to the *Antennenfuss* mounted on the rear starboard side of the *Turm* roof. All of the Pz.Bef.Wg. Panthers were prewired for both the FuG 7 and FuG 8 radio sets and the associated antennas for these. It was then a relatively simple task to fit a FuG 8 radio in order to have an *Sd.Kfz.* 267 or install a FuG 7 and the vehicle became an *Sd.Kfz.* 268. The Pz.Bef.Wg. Panther had brackets underneath the gun cleaning tools tube on the port side of the *Fahrgestell* for stowing the extension rods for the *Sternantenne D*, there were two sockets on the inner face of the starboard rear *Gepäckkasten* for mounting these extension rods when the *Sternantenne D* was fully extended. The upper socket was split and had a butterfly nut that tightened the socket enabling the rods to be held securely in place. There would be minor modifications made to these stowage brackets as series production progressed. The GG400 generator set was necessary to provide the correct wattage for the radios to allow them to be run independently of the main engine. The external appearance of the Pz.Bef.Wg. Panther should indicate which particular function the vehicle was configured to perform. The *Sd.Kfz.* 267 should have a *Sternantenne D* mounted on the porcelain insulated *Antennenfuss Nr.1* at the rear of the engine deck for the FuG 8 radio and a 2.0m *Stabantenne* on the *Turm* roof for the FuG 5. The *Sd.Kfz.* 268 should have a 1.4m *Stabantenne* mounted on the *Antennenfuss* on the port side of the engine deck for the FuG 7 radio and a 2.0m Stabantenne on the *Turm* roof for the FuG 5[2]. Pz.Bef.Wg. Panthers were issued to the troops with all three *Antennen*, period photographs however show that all of the antennas frequently installed irrespective of whether there was a radio fitted that would receive a signal from them or not.

The gun cleaning tools tube for the Panther *Ausf*. D used spring loaded latches to secure the end caps, the sheet metal brackets for attaching the gun cleaning tools tube to the *Fahrgestell* side were at the ends of the tube between the cap and the anchor point of the latch on the tube itself. There were some variations in the length of the springs and the location of the anchor point on the tube. Pz.Bef.Wg. *Ausführung* D Panthers had the brackets for stowing the extension rods for the *Sternantenne D* mounted independently between these fixing brackets. M.A.N. would start to fit Panthers with a redesigned set of mounting brackets for the gun cleaning tools tube on the last *Ausführung* D Panthers they completed in August 1943. This design change would be introduced by all of the assembly firms on the *Ausführung* A. The redesigned mounting brackets were spaced so that they could incorporate the brackets for the *Sternantenne D* extension rods when fitted to Pz.Bef.Wg. Panthers. There was a relatively short transition period during which the assembly firms used up existing stocks of the older design which saw small numbers of *Ausführung* A Panthers fitted with the older bracket design up to the beginning of 1944. Around this time Daimler-Benz would start to fit a new design of latch to secure the end caps on the tube. These would initially be installed so that the handle on the cap was vertical but would later be changed when Daimler-Benz started to fit the sheet metal

1 D655/2: *Pz.Kpfw. Panther Ausführung A, D und G Befehls- Panther Ausf. A, D. und G Gerätebeschreibung und Bedienungsanweisung zum Turm.* (*Heeres-Waffenamt* 1944).

Jentz and Doyle: *Germany's Panther Tank, The Quest for Combat Supremacy*.

2 D655/2: Ibid.

Opposite Page:
The brackets for mounting the *Nachfriströhre* (Antenna extension tubes) can just be made out on the inner face of the starboard *Gepäckkasten* (stowage box) on the rear of this very early production *Pz.Bef.Wg.* Panther *Ausführung* A. This vehicle was one of a small number of the new *Ausführung* A Panther completed with the early commander's cupola by M·A·N in September 1943. Note the armoured pot for the *Antennenfuss* for the *Sternantenne D* mounted on the engine deck. The haphazard *Zimmerit* application around the spare track stowage suggests that this paste was applied at a later stage of construction than would be the norm within a few weeks. (Johann Buchner M·A·N)

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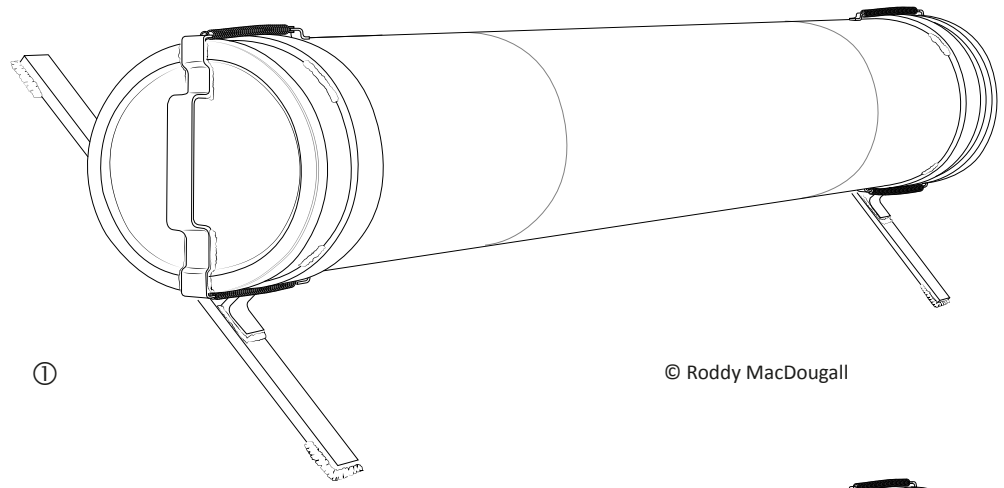
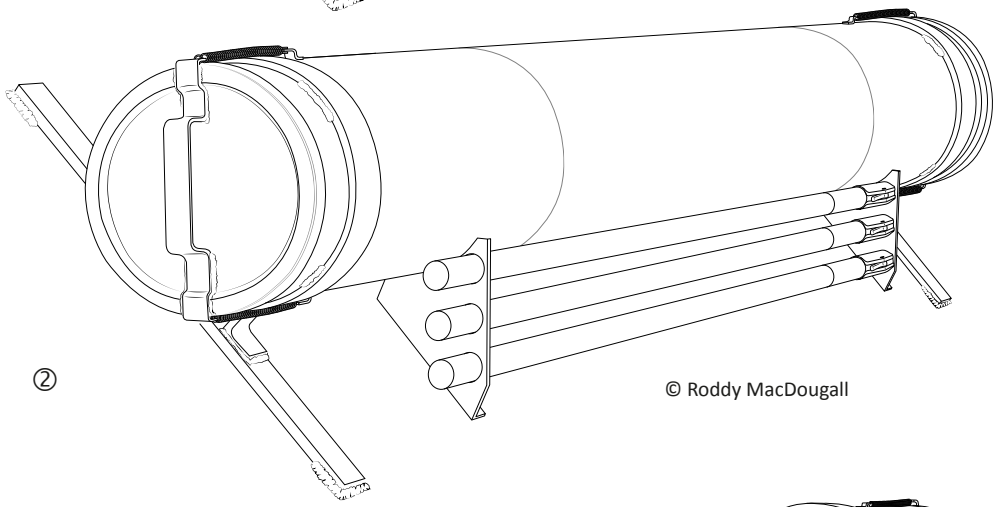
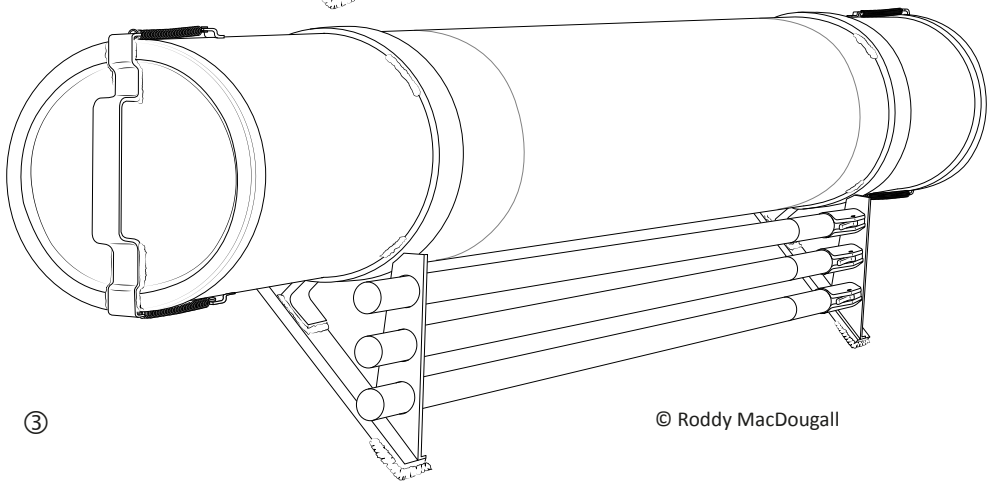


① © Roddy MacDougall



② © Roddy MacDougall



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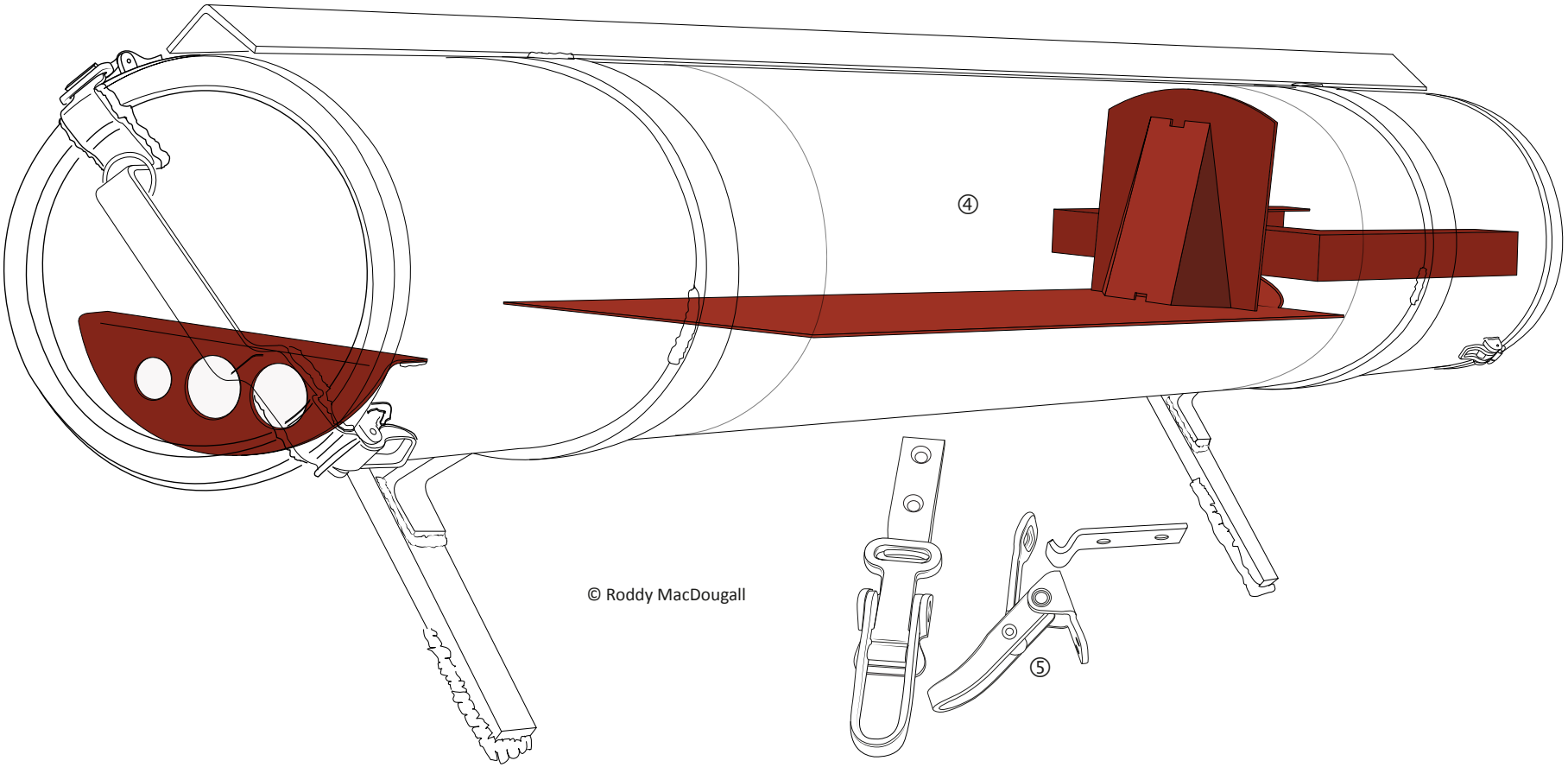
Gun Cleaning Tools Tube *Ausführung* D and A

① The mounting brackets were redesigned by moving them towards the centre of the gun cleaning tools tube. The distance between them was determined by the desire to incorporate the *Nachfriströhre* stowage into the bracket which reduced the number of components that needed to be welded to the armour face. This design modification was present on *Ausführung* D Panthers and *Pz.Bef.Wg.* Panthers completed by M·A·N in August 1943 and would be introduced to series production *Ausführung* A Panthers without the *Nachfriströhre* stowage brackets.

② The *Nachfriströhre* (Antenna extension rods) that were part of the standard equipment for the *Sd.Kfz.* 267 or *Sd.Kfz.* 268 *Pz.Bef.Wg.* Panthers were mounted on sheet metal brackets that were welded to the *Wanne* sides and the bottom of the tube on the majority of *Ausführung* D Panzerbefehlswagen Panthers. There is some variation on the design of these brackets as well as the size and location of the weld beads that held them in place. One of the disadvantages of this arrangements was that two sets of brackets were welded to the face hardened armour plate on the *Wanne* side. The designers had striven to avoid or reduce the number of components that were welded to the face hardened sections of armour in case the heat generated during the arc welding process had a detrimental effect on the ballistic properties of the armour. This was the main reason for using extensions that were welded to the *Wanne* roof and sponson floor on the early design of tool stowage brackets.

③ The mounting brackets were redesigned by moving them towards the centre of the gun cleaning tools tube. The distance between them was determined by the desire to incorporate the *Nachfriströhre* stowage into the bracket which reduced the number of components that needed to be welded to the armour face. This design modification was present on *Ausführung* D Panthers and



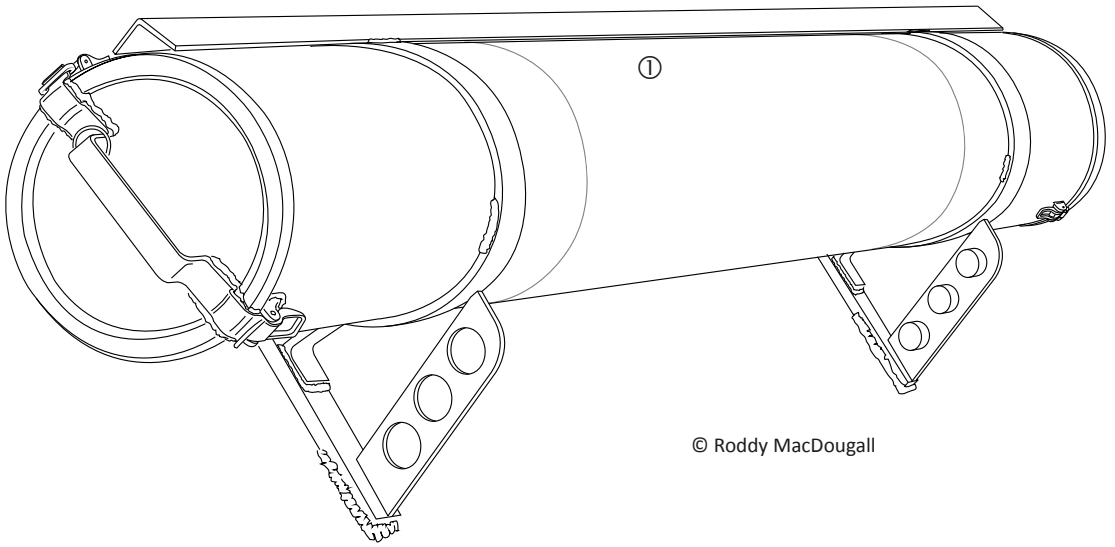
Pz.Bef.Wg. Panthers completed by M·A·N in August 1943 and would be introduced to series production *Ausführung* D Panthers without the *Nachfriströhre* stowage brackets by M·A·N in August 1943. The redesigned gun cleaning tools tube would then be introduced to series production *Ausführung* A Panthers by Daimler-Benz, M.N.H. and Demag without the *Nachfriströhre* stowage brackets.

④ The tube was fabricated in three sections to accommodate the internal shelving for the spare *Antennen* and gun cleaning tools. There was a sheet metal bulkhead that formed a partition that incorporated a "U" channel section for a wooden fitted tray on one side and a shelf on the other that ran up to the forward weld seam in the tube. The shelf would support the rods used to pull the cleaning brush through the gun barrel. The tray was routed to hold the various accessories used in maintaining the main gun. This is almost always missing in period photographs possibly indicating that its issue was discontinued at some point. It does however appear on the list of equipment issued with new Panthers. The lower section of the bulkhead was left open to allow spare 2.0m and 1.4m rod *Antennen* to be stored along the bottom of the tube with the ends secured in the perforated sheet metal bracket at the front of the tube.

⑤ The spring fasteners for the tubes end caps were replaced with latches starting with Daimler-Benz on the Ausführung A completed in late Autumn 1943. A similar pattern of latch was already in use on the *Gepäckkasten*. An "angle iron" strengthening brace would be welded to the top of the tube of *Ausführung* A Panthers from December by Daimler-Benz and M.N.H. slightly later in January 1944.

Gun Cleaning Tools Tube *Pz.Bef.Wg. Ausführung* G

① The "angle iron" strengthening brace would not be fitted to the Panthers completed by M·A·N until the switch to *Ausführung* G production in March 1944. The tubes internal brackets were designed to the tools stowed with level on the 40° *Wanne* side on the *Ausführung* D and A, the design was not altered to compensate for the change in the angle of the *Wanne* armour sides to 30° on the *Ausführung* G so that the internal shelves on the gun cleaning tools tube were 10° of level on the entire *Ausführung* G production series.



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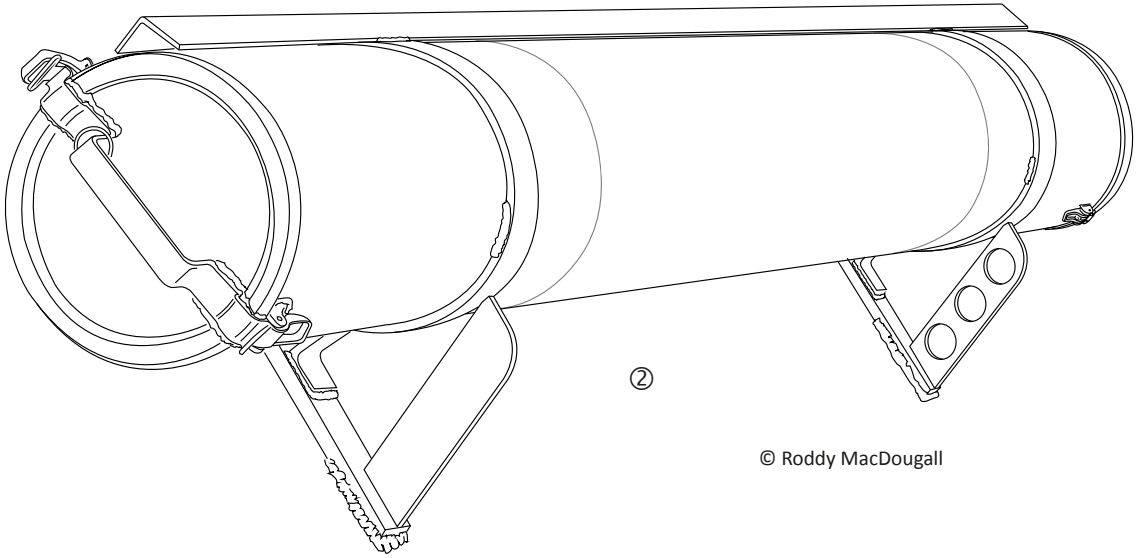
② There would be a further minor alteration to the *Nachfriströhre* mounting brackets in August 1944 when the brackets were reversed to allow the rods to face the opposite direction with their clamps facing the front of the vehicle. When travelling through dense foliage this arrangement was less prone to working loose when the levers that fastened them were caught on branches. The gun cleaning tools tubes were manufactured by sub contractors and were delivered as completed sub components to the assembly firms. The design of the tube was dependent on the specification laid out in the purchase contract given to the sub contractor. This resulted in a transition period where tubes were being manufactured simultaneously using the latest design drawings as well as tubes being fabricated using the older specification laid out in their relevant purchase orders. The older tubes would not be scrapped as these were still fit for their intended purpose and there was always a transition period where the *Heeres-abnahmestelle* inspectors would accept vehicles with the older components fitted.



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A Pz.Bef.Wg. Panther *Ausführung* A from I./Pz.Rgt. 4 that was knocked out in the vicinity of San Giovanni, Italy in late May 1944. The stencilled *" Wischer u Stange"* (cleaner and rods), *"3 Nachfriströhre"* (extension tubes) and *"3 Antennen"* markings can be made out on the side of the gun cleaning tools tube. This was is accompanied by *"Ve. Kl.: S"* inside a thin stencilled box outline at the rear of the tube; this was an abbreviation of *Verladeklasse Schwer* or heavy load class which was required for transport by the *Deutsche Reichsbahn*. The vehicle has been finished in a coat of *Dunkelgelb* RAL 7028 paint that appears to be devoid of any further camouflage. The anti spall grid on the *Zimmerit* paste on the Turm of M·A·N assembled Panthers almost invariably have seven horizontal scores leaving eight horizontal rows on the *Turm* sides of Panthers completed with a coating of *Zimmerit* paste that has been rolled horizontally. (NARA via Darren Neely)

"angle iron" reinforcement to the top of the tube in December 1944[3]. M.N.H. would start to fit the new latches in early 1944 and the "angle iron" brace shortly after this. M·A·N would also start fitting the new latches in December 1943 but would appear not to fit the "angle iron" brace until commencing production of the *Ausführung* G. Both M·A·N and M.N.H. would install the new latches so that the handles on the end caps were vertical until they started to fit the "angle iron" brace. A small number of Panthers were completed by either Daimler-Benz or M.N.H. with the latches fitted at an angle but without the "angle iron" reinforcement. The mounting brackets for the *Nachfriströhre* would be reversed so that the clamps on these now faced the front in August 1944. Prior to this change the *Nachfriströhre* were held in place by putting the blank end through one of the three holes in the forward bracket and using the clamping the other end to a corresponding socket on the opposite bracket. When travelling through dense foliage this arrangement was prone to working loose when the lever that fastened the clamp was caught on branches. Reversing the brackets significantly reduced the chances of this happening.

Field Expedients

There was a shortfall in numbers of *Sd.Kfz.* 267 or *Sd.Kfz.* 268 Pz.Bef.Wg. Panthers that were completed compared to the demand for these important vehicles from the units serving at the front. This necessitated some units to add additional radio equipment to a standard *Sd.Kfz.* 171 Panther tank in order to try and address the deficiency in the unit's communication requirements. However this does not in itself make the vehicle an *Sd.Kfz.* 267 or *Sd.Kfz.* 268 Pz.Bef.Wg. Panther. There are several period photographs that show vehicles with an extra antenna base mounted on the turret side, *Fahrgestell* roof or the *Sternantenne D* fitted to the normal *Antennenfuss* used for the vehicle's FuG 5 radio on the port side of the engine deck. There are a number of reasons why it is extremely unlikely that these were genuine *Sd.Kfz.* 267 or *Sd.Kfz.* 268 Pz.Bef.Wg. Panthers converted from standard vehicles by *Werkstatt* units. The *Sternantenne D* was normally used with the powerful FuG 8 radio set that was part of the communications equipment of an *Sd.Kfz.* 267 Pz.Bef.Wg. Panther, it could, in an emergency, be used in place of a 2.0m rod antenna for the FuG 5. This would result in reduced performance for the FuG 5 radio as a specific rectifier was in place to correct the imbalance between the FuG 5 radio and the 2.0m antenna. A FuG 8 radio set was highly unlikely to have used the standard *Antennenfuss* on a Panther as this radio needed a large porcelain insulator due to the very high wattage and voltage that this set required to work normally and could have been hazardous to both the vehicle and crew if operated without this. It should be noted that the replacement of antennas was a frequent task for the crews, as the antennas were often damaged during battle and transport in rough terrain. *Pz.Bef.Wg.* Panthers fulfilled a very valuable function within the Panzer Regiments and were necessary in order for the *Regiment* and *Abteilung* commanders to maintain command and control over their troops as well as communicate with their senior command elements. If lost or disabled a replacement would be sought immediately, however, there are less than a handful of photographs that might show a genuine field expedient Pz.Bef.Wg. Panther. Converting a standard *Sd.Kfz.* 171 Panther tank into an *Sd.Kfz.* 267 or *Sd.Kfz.* 268 Pz.Bef.Wg. was not an easy task. The conversion would require a considerable engineering effort that would include what would almost amount to a full strip down of its mechanical components and wiring loom in order to complete the conversion. This work would include fitting a GG400 generator set and its exhaust system in the starboard sponson floor after removing the ammunition racks located there[4], changing the vehicle's wiring loom to accommodate the new power requirements, this would include new electrical contacts in the base of the *Turm* as well as fitting the extra relevant Antennenfuss and brackets for all of this new equipment. This was not impossible if the engineering resources were available, more often than not the resources needed were not available so that evidence of any conversion is remarkably rare. There is a real danger of descending into semantics when discussing Pz.Bef.Wg. Panthers, a true Pz.Bef.Wg. Panther could be either an *Sd.Kfz.* 267 or *Sd.Kfz.* 268. The addition of an extra radio does not turn a standard *Sd.Kfz.* 171 into a Pz.Bef.Wg. Panther. As previously mentioned a company commander or platoon leaders *Sd.Kfz.* 171 Panther could be fitted with both a FuG 5 and a FuG 2 radio set[5]; the presence of these two radios did not make the vehicle a Pz.Bef.Wg. An absurd extension of this argument could see any armoured vehicle that a commander issued any orders from being described as a Pz.Bef.Wg. This was the case throughout the entire production history of the Panther *Ausführung* D, *Ausführung* A and almost all of *Ausführung* G production.

3 Panther *Fgst.Nr.* 152158 completed on or about 18th December 1943 has the "angle iron" brace and the new clips. The clips are mounted so that the end cap handles are vertical. A shortened "angle iron" brace has been fitted to accommodate this.

4 It should be noted that the GG400 generator was necessary to power the vehicle's radios when the Maybach HL230P engine was not running. The radios would only operate with a considerably reduced wattage and range on the vehicles batteries which would very quickly be depleted with potentially disastrous consequences in a combat situation.

Opposite Page:
This photograph taken at Hainberg in August 1944 shows the radios and *Umformers* (transformers) being installed in a *Pz.Bef.Wg.* Panther in order to test the installation as part of the *Abnahmestelle* procedure for this vehicle. The *Turm* front plate casting still has the white paint used to highlight measurements applied to it during its initial machining. This has not been given a complete coat of *Zimmerit* paste with only the trunnion armour receiving a coating on the cheeks. The number 65 has been chalked onto the tow cables stowage post. It was common practice at M·A·N to mark the last two digits of the *Fahrgestell* number on the exterior of partially completed vehicles so that they could easily be identified. (Johann Buchner M·A·N)

Markings

One of the more prominent factory applied markings on the exterior of the Panther was the legend "*Wischer u Stange*" (cleaner and rods) stencilled on the side of the gun cleaning tools tube. This was often accompanied by "*Ve. Kl.: S*" inside a thin stencilled box outline; this was an abbreviation of *Verlade Klasse Schwer* or heavy load class which was required for transport by the *Deutsche Reichsbahn*. This was accompanied by "*3 Nachfriströhre*" (extension tubes) and "*3 Antennen*" on a number of Pz.Bef.Wg. Panthers. Some vehicles were also marked with a stencil that provided important information regarding the motor's cooling system either on the engine deck or the rear armoured plate, this will be discussed in more detail in chapter 9. The majority of the interior and exterior information markings were applied with a stencil using the "*Prüßische IV 44 Ausgabe 3*" font. This font was officially specified for the *Deutsche Reichsbahn* (German state railway) rolling stock. The overwhelming majority of engineering firms involved in the production of Panzers were also involved in the production of railway rolling stock so were already familiar with this type of marking and its associated stencils.

Wischer u Stange

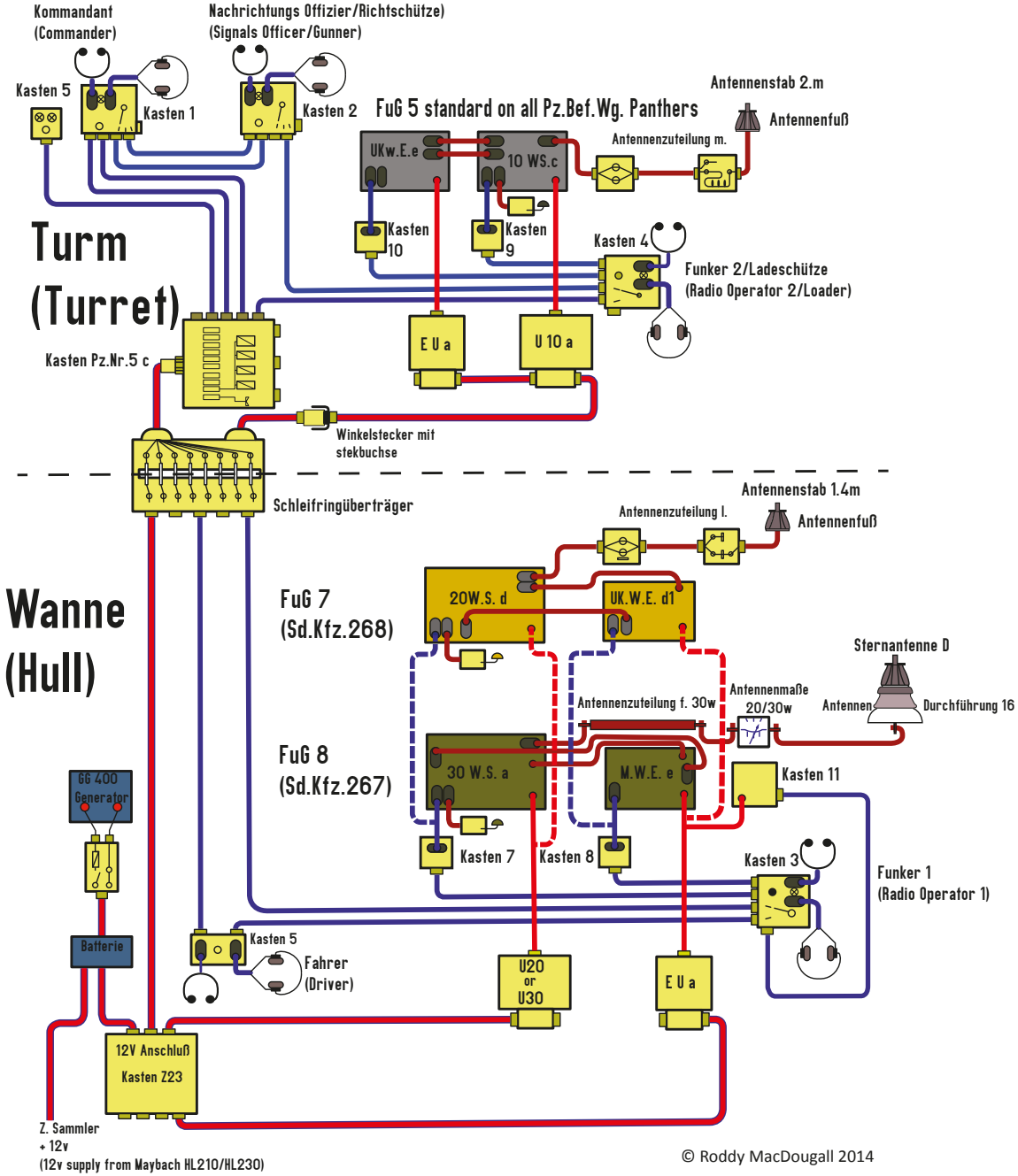
3 Nachfriströhre 3 Antennen

Ve. Kl: S

Right:
The *"3 Antennen"* markings can clearly be made out on the side of the gun cleaning tools tube on this *Pz.Bef.Wg.* Panther Part of the *"3 Nachfriströhre"* marking is just legible on the left side of the gun cleaning tools tube. This *Pz.Bef. Wg.* Panther is from I./Pz.Rgt. 4 who served in the Italian campaign. It has the tactical number I02 in red with a thin white outline applied to the *Turm* sides. The vertically textured rows indicate the vehicle was completed between September or early October 1943, the subject of *Zimmerit* will be dealt with in more detail in the following chapter. The weld seam on the gun cleaning tools tube is quite noticeable in this photograph as is the *Antennenfuss* on the *Turm* roof for the 2.0m *Stabantenne*. The *Fliegerbeschussgerät* device (M.G.34 anti aircraft mount) has been fitted to the ring on the commander's cupola. (Bundesarchiv 101I-478-2165-22A, KB Bayer)

Wiring Diagram for the *Pz.Bef.Wg.* Panther

The *Sd.Kfz.* 267 and *Sd.Kfz.* 268 had the FuG 5 radio mounted on the starboard side of the *Turm* to allow the space in the *Fahrgestell* to be used for the more powerful radio sets fitted to these vehicles. A 2.0m *Stabantenne* was fitted to the *Antennenfuss* mounted on the rear starboard side of the *Turm* roof. All of the *Pz.Bef.Wg.* Panthers were prewired for both the FuG 7 and FuG 8 radio sets and the associated antennas for these. It was then a relatively simple task to fit a FuG 8 radio in order to have an *Sd.Kfz.* 267 or install a FuG 7 and the vehicle became an *Sd.Kfz.* 268. The *Sd.Kfz.* 267 should have a *Sternantenne* D mounted on the porcelain insulated *Antennenfuss* Nr.1 at the rear of the engine deck for the FuG 8 radio and a 2.0m *Stabantenne* on the *Turm* roof for the FuG 5. The *Sd.Kfz.* 268 would have a 1.4m *Stabantenne* mounted on the *Antennenfuss* on the port side of the engine deck for the FuG 7 radio and a 2.0m *Stabantenne* on the *Turm* roof for the FuG 5.



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This photograph of a an *Sd.Kfz.* 267 Pz.Bef.Wg. Panther *Ausführung* A from SS-Pz Rgt. 12 was probably taken between 27th and 29th April 1944 during a battlegroup exercise in France. *Ostubaf.* Max Wünsche in the cupola and *Ostubaf.* Wilhelm Mohnke can be seen sitting on the vehicle. This *Panzer Befehls Wagen* was completed by M·A·N in December 1943 or January 1944 with pistol ports in the *Turm* and the original twin exhaust stack configuration. One of the *Nachfriströhre* (Antenna extension tubes) has been dislodged from its stowage bracket underneath the gun cleaning tools tube, this was a common occurrence when travelling through dense foliage. The two brackets used when the *Nachfriströhre* were attached to the *Antenne* can be seen on the inner face of the starboard *Gepäckkasten* (stowage box) on the rear plate. The design of these brackets remained unchanged from the first *Ausführung* D *Panzer Befehls Wagen* Panthers through to the *Ausführung* G Panthers completed in the beginning of August 1944. (NARA via Darren Neely)

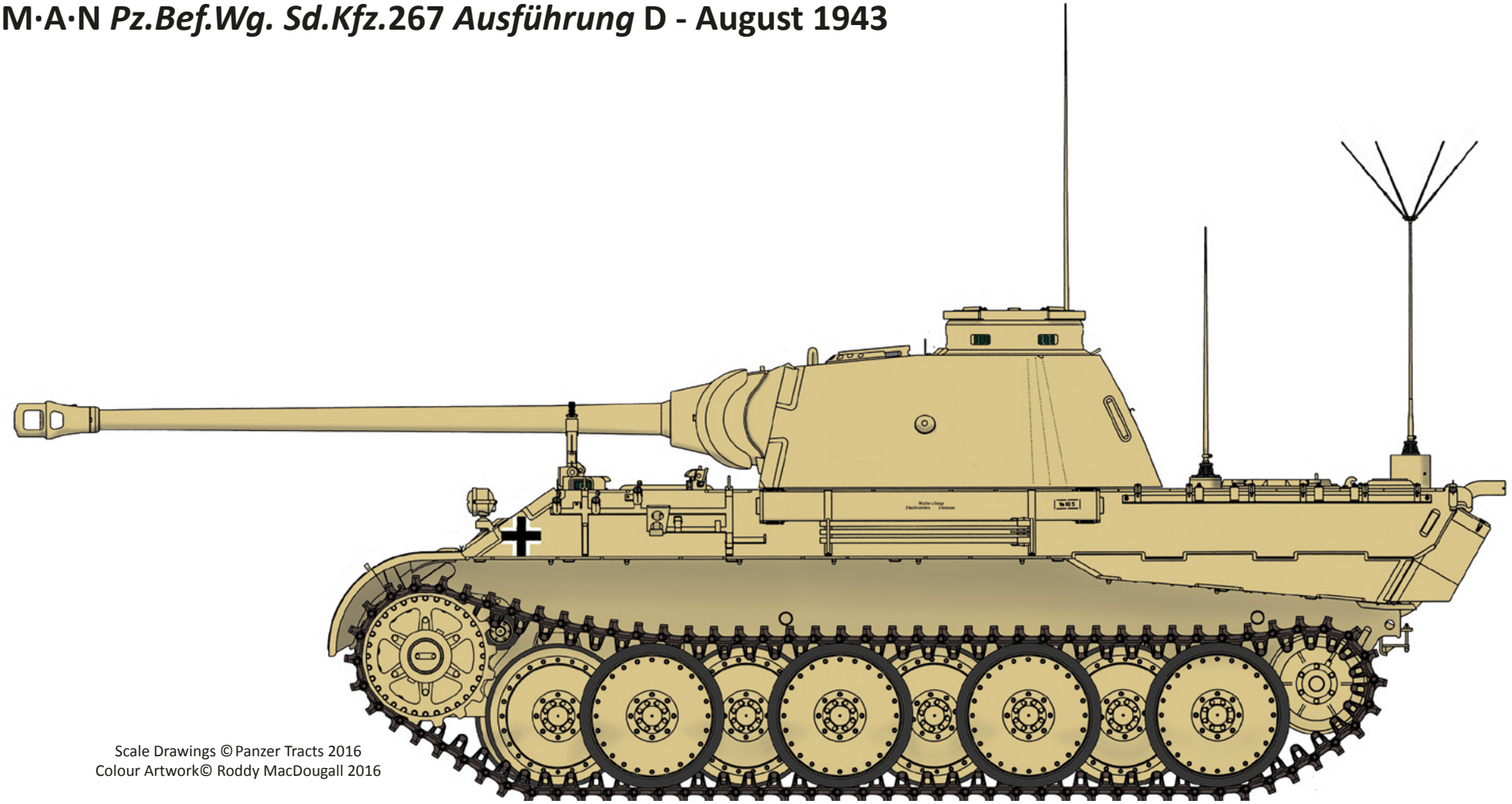
This *Panzer Befehls Wagen* Panther *Ausführung* G from II./Pz.Rgt. 33 was knocked out or abandoned in Wilwerdange, Luxembourg at the end of the Ardennes Offensive. It has the later single piece pattern mounting bracket for the *Nachfriströhre* (Antenna extension tubes) on the inner face of the starboard *Gepäckkasten*. I also has the reversed stowage brackets for these rods underneath the gun cleaning tools tube. It was completed in September or early October 1944 and was painted in the "Classic" factory camouflage scheme at the M·A·N assembly plant. This has been obscured by a coat of winter whitewash when this photograph was taken. It was fitted with the 600mm diameter early *Leiträder* (idler wheels) and has an intermediate pattern strengthened gun mantle. The coaxial MG.34 aperture has been plugged as the internal space for the weapon was used for the electrical transformers that were necessary for the *Turm* mounted FuG 5 radio set. The gun mantle is the intermediate strengthened version used on a number of Panthers from June to late October 1944. (NARA via Darren Neely)

There were at least two Panther fitted with extra non standard radios serving with units that took part in the Ardennes Offensive in December 1944. This Panther from 111./Fhr.Gren.Brig. was knocked out in the village of Eschdorf, Luxembourg. It was completed by M·A·N in August 1944 and has been fitted with *Lost Erkennungstafeln* (Poison Gas Indicator panels) on the *Turm* roof. It has an additional *Antennenfuss* mounted on a bracket on the Turm side,the cable for this has been fed through an aperture drilled in the *Turm* roof and has been fed through protective trunking to the *Antennenfuss* base. This Panther was completed with a full coat of *Zimmerit* anti-magnetic paste,sections of this have been removed to allow the bracket and trunking for the *Antennenfuss* to be welded in place along with brackets for lengths of spare track that were mounted as additional armour on the sides of the Panthers issued to 111./Fhr.Gren.Brig. in September 1944.(NARA via Darren Neely)

This Panther from I./Pz.Rgt. 3 was photographed at a vehicle dump outside Stuppach in Germany. It was completed by Daimler-Benz in November 1944. It has been modified to carry an extra radio set in the *Turm*, the *Antennenfuss* for this has been mounted on the turret side with the cable leading to this being fed through a hole drilled in the *Turm* side armour. The commander's cupola and *Turm* roof has been blown out by an internal explosion, there is a radio in its mounting frame balanced on the edge of the roof, it is difficult to be certain but this appears to be a FuG 5 unit. This Panther was finished in the standard "Classic" factory applied camouflage scheme applied by Daimler-Benz to all of the Panthers they assembled from September 1944 to April 1945, the camouflage schemes used by the various assembly plants will be discussed in detail in chapter 7. (NARA via Darren Neely)

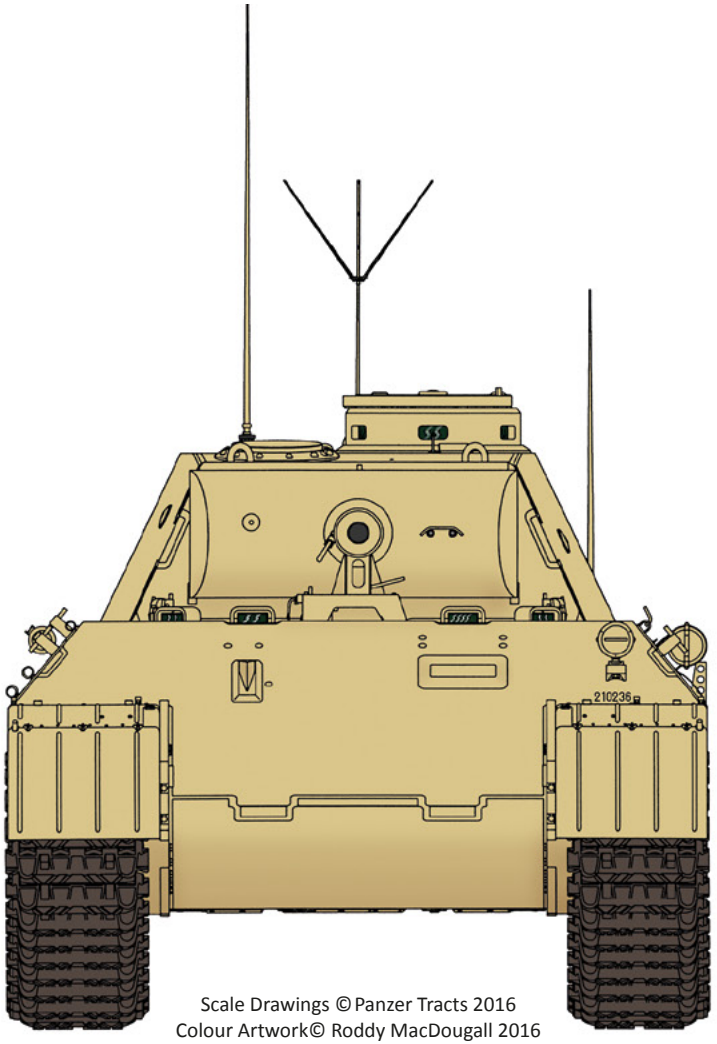
Two brand new *Ausführung* G *Pz.Bef.Wg.* Panthers at Warsaw on their way to the front. Both Panthers, these vehicles appear to be two of a number of *Ausführung* G *Pz.Bef. Wg.* Panthers that have their have *Balkenkreuze* (National markings) painted on the sides of their *Turme* but do not have The roughly painted flat topped "A" typically applied to M·A·N vehicles indicating their acceptance by the *Heeres-Abnahmestelle* inspectors applied to the external gun travel lock. There are photographs of *Ausführung* G *Pz.Bef.Wg.* Panthers with this "A" marking as well as a M·A·N *Fahrgestell* number either on the travel lock or the vehicles glacis plate. there is also at least one photograph that shows an *Ausführung* G Panther with both a *Fahrgestell* number and an "A" marking along with the black "G" painted on the glacis plate indicating that the vehicles motor coolant had been treated with *Glysantin*, so that these three markings are not mutually exclusive. (Darren Gawle & Roddy MacDougall)

M·A·N *Pz.Bef.Wg. Sd.Kfz.*267 *Ausführung* D - August 1943



Scale Drawings © Panzer Tracts 2016
Colour Artwork© Roddy MacDougall 2016

This series of colour plates represent the typical appearance of an *Sd.Kfz.*267 and *Sd.Kfz.*268 *Panzer Befehls Wagen* or *Pz.Bef.Wg*. Panther completed in August 1943. A ring mount for a *Fliegerbeschussgerät* (anti aircraft mount for an M.G.34) and a bump stop for the hatch were welded to the commander's cupola, this modification had been implemented in June and was commonly retro fitted to older vehicles having remedial work carried out under the *Kampf Versandberiet* programme. At the end of June 1943 the assembly plants started to complete Panthers without the *Verständigungsöffnung* (communications port) on the port side of the Turm. The implementation of this design modification was driven by the delivery of Türme from the armour manufacturers that did not have the aperture for the *Verständigungsöffnung* flame cut in the *Türme* sides. The external appearance of the *Pz.Bef.Wg.* Panther should indicate which particular function the vehicle was configured to perform. The *Sd.Kfz.*267 should have a *Sternantenne* D mounted on the porcelain insulated *Antennenfuss* Nr.1 at the rear of the engine deck for the FuG 8 radio and a 2.0m Stabantenne on the *Turm* roof for the FuG 5. The *Sd.Kfz.*268 should have a 1.4m *Stabantenne* mounted on the *Antennenfuss* on the port side of the engine deck for the FuG 7 radio and a 2.0m *Stabantenne* on the Turm roof for the FuG 5. *Pz.Bef.Wg.* Panthers were issued to the troops with all three *Antennen*, period photographs however show that all of the antennas frequently installed irrespective of whether there was a radio fitted that would receive a signal from them or not. The second Bosch headlamp on the starboard side of the glacis plate was dropped along with the armoured cover for the Schnorchel in June. The *Sternantenne* D was mounted on an



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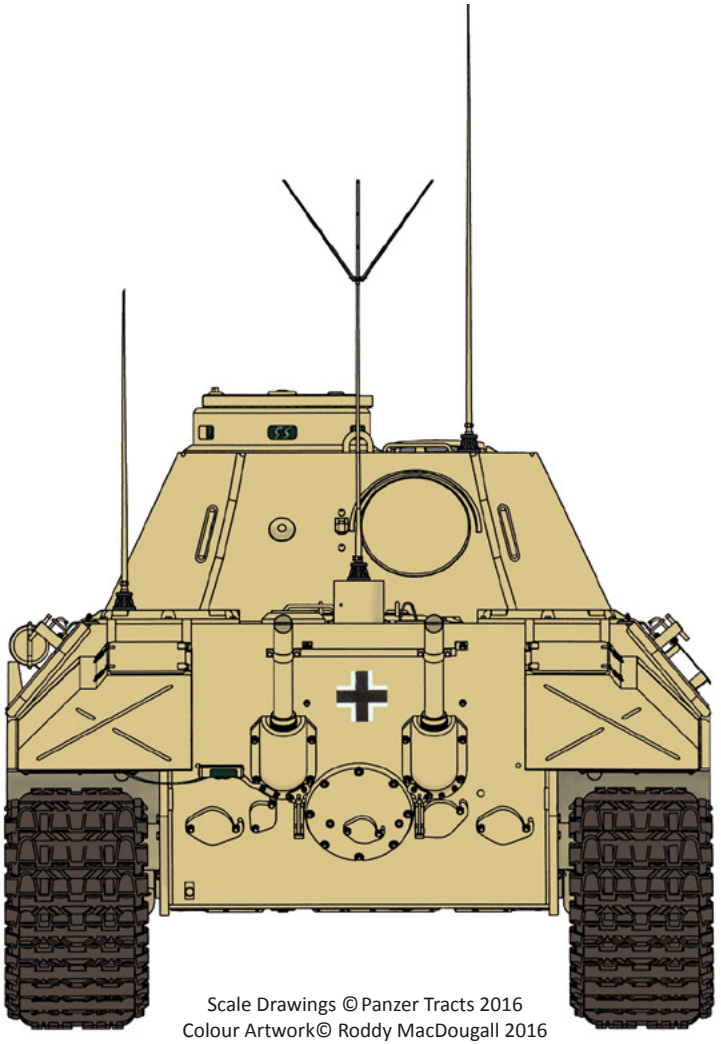

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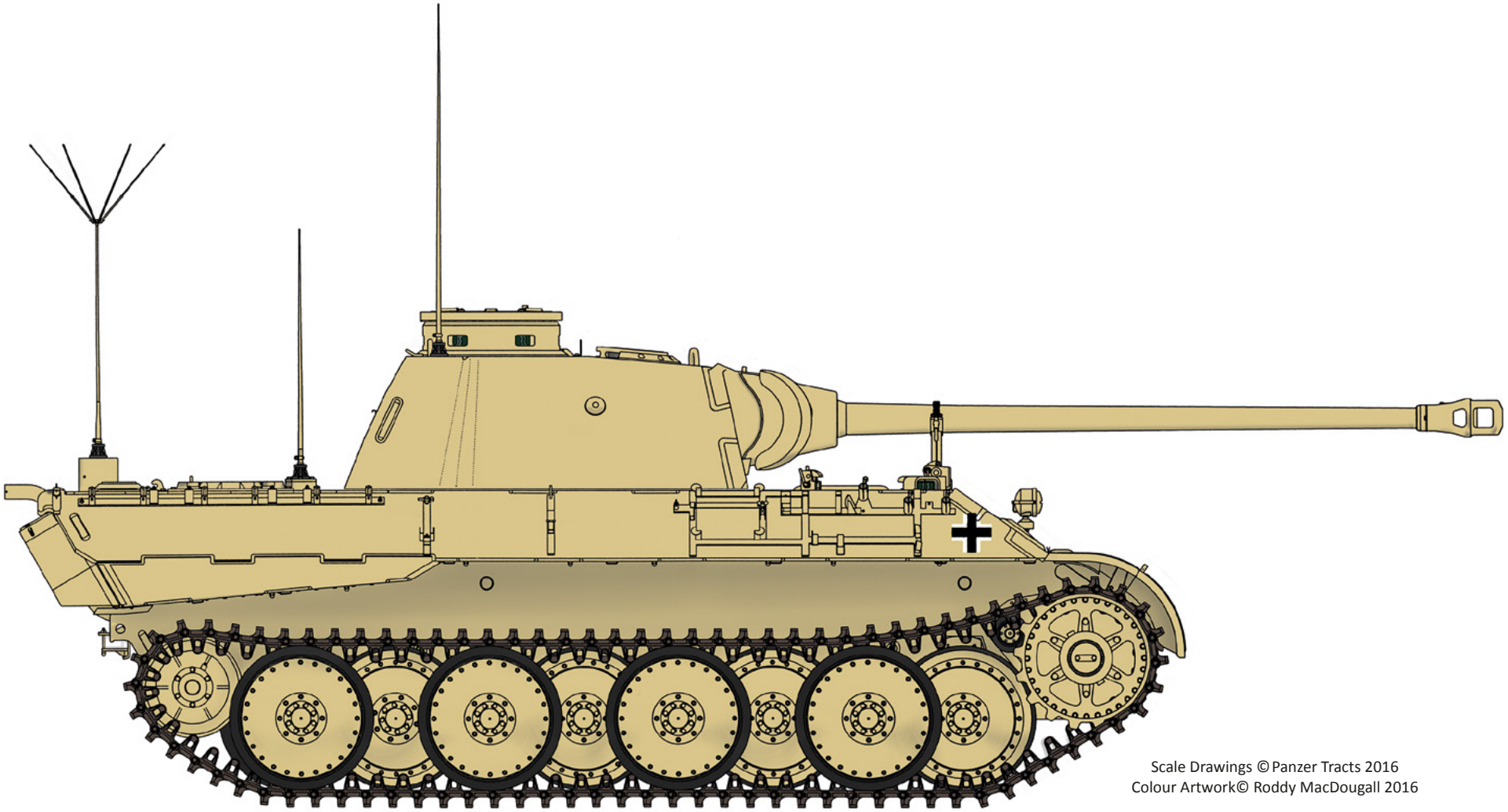
***Antennenfuss* Nr.1 on top of a porcelain insulator at the rear of the engine deck. This was protected by a forged armoured pot with three drain holes evenly spaced around its circumference. These were required to drain off any build up of rain water that might interfere with the electrical insulation of the *Antenne*. In February 1943 *Heeresmitteilung Nr.181 (General Order Nr.181)* was issued on 18th February 1943 to change the base coat from *Dunkelgrau* to *Dunkelgelb nach Muster*, which was not in fact yellow but a tan colour. Field units were issued tins of *Rotbraun* RAL 8017 (red brown) and *Olivgrün* RAL 6003 (dark olive green) acrylic paste concentrate that was applied by the vehicles' crews or the unit *Werkstatt* to create camouflage patterns suitable for local conditions. This practice continued after Panzers were covered with anti-magnetic *Zimmerit* starting in August 1943). There were various markings applied to the exterior of the Panther at the assembly plants. At one stage or another M·A·N, Henschel, Demag, M.N.H. and Daimler-Benz all stencilled the vehicle's *Fahrgestell* number somewhere on the vehicle's exterior. One of the most common locations for this number on the *Ausführung* D was underneath the Bosch headlamp on the port side of the glacis. This could also be accompanied by the Panther's motor number stencilled underneath the *Fahrgestell* number. The practise of stenciling the motor number to the glacis plate appears to be limited to those *Ausführung* D Panthers undergoing remedial work as part of the *Kampf Versandbereit* programme. With the exception of the motor number the markings on this colour plate including**



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the Fgst.Nr. 210236 represent those that might be applied to a typical *Pz.Bef.Wg.* Panther completed at the end of *Ausführung* D series production in August 1943 based on period photographs of vehicles completed at that time. There were no new Panther Ausführung D completed with a coat of *Zimmerit* anti magnetic paste at the assembly plants. Any Zimmerit coating present on *Ausführung* D Panthers was applied when these vehicles were undergoing maintenance, it was not applied at the assembly plants as the instructions to commence the application of *Zimmerit* paste was not issued until the assembly plants had switched over to series production of the new *Ausführung* A Panthers. The last two modifications officially introduced to *Ausführung* D series production in August 1943 were modified Kgs64/660/150 caterpillar tracks which had 6 *Gleitschutzpickeln* chevrons on the grouser face and road wheels with 24 rim bolts. There is no evidence that any series production *Ausführung* D Panthers were fitted with the new tracks at the assembly plants. There were sufficient stocks at the assembly plants to enable the older design of tracks to be fitted for some weeks after series production of the *Ausführung* A had commenced

5. PANTHER AUSFÜHRUNG A

The decisions that led to the production of the *Ausführung* A series were being discussed in detail at a meeting between *Wa.Prüf 6* and Rheinmetall on 18th February 1943. The modifications agreed upon would be implemented from the 851st Panther assembled onwards[1]. It was not intended to implement drastic changes to the *Wanne* design, which would remain the same as that for the *Ausführung* D with the exception of a redesigned *Turm* race. The main change that would denote an *Ausführung* A from an *Ausführung* D was a new design for the *Turm*. The basic appearance and dimensions for the old and new design of *Turm* were almost identical. The external changes for the new design were the incorporation of a loader's periscope, the transition from dovetailed armour interlocks to parallel interlocks for the casting that incorporated the front plate and trunnion armour and a new design of cast armoured commander's cupola with seven periscopes. The new casting for the front plate/ trunnion armour now had dish shaped convex bulges on the sides over the gun trunnion that was necessary to accommodate new waterproof seals. The dimensions of the *Turm* race for both *Turm* designs was identical but the profiles of the race itself were different so that it is not a simple task to take the *Turm* from an *Ausführung* D and mount it on an *Ausführung* A chassis or vice versa. It is possible to carry out such a conversion if the engineering facilities are available to carry out the precision machining and adjustment necessary to fit a suitable race for the new *Turm* and its ring. There were other component changes necessary but the ring and its race were the biggest obstacles to overcome. Only three such possible conversions have turned up in the last seven decades since the end of the war and there is insufficient evidence to indicate whether or not the *Türme* on these vehicles were fully operational. The overwhelming majority of *Ausführung* D *Stahlbau* returned to Germany for factory maintenance were sent to B. Seibert-Stalhau GmbH at their Aschaffenburg facility. The Bergepanther conversion programme undertaken by this firm accounted for the majority of the *Ausführung* D and early *Ausführung* A *Fahrgestell* with the turrets from these vehicles being refurbished and sent out as a kit that included a stand incorporating the traverse race and gear to *Festungspioniere* for use as fixed Panther *Stellung* emplacements[2].

The war situation in Germany in late 1943 and early 1944 did not seriously affect production at any of the assembly plants. The design modifications that affected the external appearance of the *Ausführung* A after its introduction were introduced smoothly at all of the assembly plants during this period. Major modifications such as the introduction of the *Kugelblende* ball mount for the glacis mounted MG.34 machine gun were driven by these design modifications being implemented by the armour manufacturers and the delivery of *Wannen* and *Türme* that incorporated these modifications to the assembly plants. The assembly plants in turn did not necessarily commence assembly using all of the components delivered to them before using any design that had recently been modified so that it is possible for a vehicle to have been assembled without design modifications or new components after other vehicles from the same assembly plant where these modifications or new components were present. Having said that there are very few instances where older components were used by any of the assembly plants after they had introduced a new component or design change. The vigorous enforcement of the stringent *Heeres-Abnahmestelle* procedure introduced from September 1943 on ensured that each of the assembly plants introduced design modifications smoothly during the production run of the *Ausführung* A in response to the instructions they received from the *Heeres-Waffenamt*.

1 Jentz and Doyle: *Germany's Panther Tank, The Quest for Combat Supremacy*.
2 Jentz, Doyle and Friedli: *Panzer Tracts No.16-1 Bergepanther Ausf. D, A, G.*

Opposite Page:
The first 3 *Ausführung* A Panthers were completed by M.N.H in the last week of August 1943 without a coating of *Zimmerit* anti magnetic paste. Neither M.N.H. or Daimler-Benz had been instructed by the *Heeres-Waffenamt* to commence the application of *Zimmerit* until the last week of September at the earliest for M.N.H. and early October for Daimler-Benz so that both assembly firms delivered their first *Ausführung* A Panthers for service with the *Wehrmacht* without this distinctive coating. This close up of Panther "Elna" from I./Pz.Rgt. 6 is one of the early Panther *Ausführung* A completed by Daimler-Benz without a coating of *Zimmerit*. The *Wanne* was manufactured by Ruhrstahl Hattingen (bwx) and has the flush cut interlocking joints around the armoured extensions to the sponson that incorporated the fuel tanks. This design variation was unique to *Wannen* manufactured by this armour manufacturer. This Panther was completed without a ring mount for the *Fliegerbeschussgerät* (M.G.34 anti aircraft mount) and has the shortened bump stop for the commander's hatch. The commanders cupolas were sourced from specialist sub contractors, these could be supplied as completed components or as castings that were then finished by the main assembly firms. Daimler-Benz were not informed of the design change to incorporate this ring mount until after they had commenced deliveries of the new series so that a number were accepted for service without the *Fliegerbeschussgerät* ring. (NARA via Darren Neely)

The introduction of *Zimmerit*

One of the most innovative solutions to see widespread use on armoured vehicles serving with the Wehrmacht in WWII was that used to counter enemy infantry armed with magnetic mines. The chemical manufacturer C.W. Zimmer in Berlin developed a non ferrous paste that was used to coat the sheet metal and armoured components on Panzers. Its purpose was to create a waterproof permanent barrier that would defeat magnetic mines used by enemy infantry by increasing the distance between the magnetic contacts on the mine and the steel surface on the armoured vehicle[3].

The application of *Zimmerit* anti magnetic paste to the vertical surfaces of the Panthers was implemented in September 1943 on the *Ausführung* A. The paste itself was composed of the following materials:

- 40 % Barium sulphate – BaSO4
- 25 % Polyvinyl acetate – PVA (Mowilith 20)
- 15 % Pigment (ochre)
- 10 % Zinc sulphide – ZnS
- 10 % Sawdust

The instructions called for the surface to be textured to increase the distance between the magnetic contacts on the mine and the armour without increasing the amount of material used or unnecessarily increasing the vehicles weight from a thicker application. A grid was then scored into this to prevent the shock from a round hitting the armour plate travelling through large areas of *Zimmerit*, loosening this from the surface and causing it to spall off. The paste was applied in two coats by the assembly plants; the first was a thin foundation or base layer that would allow the thicker surface coat to bond properly to the armour or sheet metal component while it was being textured. A blowtorch was used to assist curing the base coat prior to the application of the textured surface layer. It was necessary to undertake this curing process cautiously to ensure that the volatile Mowilith 20 (this chemical mixture's Benzine content was higher than 50%) based solvents within the Polyvinyl acetate evaporated during this process rather than igniting when exposed to the naked flame. Depending on the season of application, temperature, humidity and the extent of blowtorch assistance it took between 3 and 6 days for the *Zimmerit* paste to fully cure and the solvents to evaporate completely.

3 The BIOS report *Zimmerit Anti-Magnetic Plaster for AFV's*, British Army Intelligence Report by Major. J.W. Thompson and Mr. C.E. Hollis (1945) gives an 8 day curing window however, there is a German report from November 1944 that gives the lower figure of 6 days. This report is discussed in detail on page 164..

All Panthers should theoretically have received an application of *Zimmerit* anti magnetic paste shortly after the decision was made to include a coating of this material in the specification issued to the assembly plants in August 1943. A sufficient stock of this material had to be ordered and delivered to the assembly plants. This was not limited to those plants assembling the Panther as all Panzers and Sturmgeschütz were to receive a coating of this material. This would take time and the *Heeres-Waffenamt* did not issue instruction regarding the application of *Zimmerit* to the assembly plants involved in the Panther programme until series production of the new Panther *Ausführung* A was already under way so that only M·A·N were able to complete their first *Ausführung* A Panthers with a Zimmerit coating in September. 1943

The *Zimmerit* coating applied to the last *Ausführung* D Panthers was when these vehicles were undergoing maintenance, it was not applied at the assembly plants as the instructions to commence the application of *Zimmerit* paste was not issued until the assembly plants had switched over to series production of the new *Ausführung* A Panthers. Daimler-Benz and M.N.H. did not apply *Zimmerit* to their initial *Ausf.* A Panthers as the order had not yet been received when assembly started. Two examples of this are Panther *Fgst.Nr.* 151951 completed by Daimler-Benz on or about 1st October 1943 and issued to I./Pz.Rgt. 11 which was completely devoid of any *Zimmerit* paste and Panther *Fgst.Nr.* 154810 completed by M.N.H. on or about 5th September 1943 without *Zimmerit* paste. This latter vehicle would be issued to I./Pz.Rgt. 2, a coating of *Zimmerit* paste would subsequently be applied to this vehicle and others that were issued without this coating by the unit *Werkstatt* prior to going in to action. M.N.H. would also complete a number of vehicles without *Zimmerit* paste, Panther *Fgst.Nr.* 154834 was completed on or about 21st September 1943 without a coating of *Zimmerit*. It would be late September or possibly early October 1943 before M.N.H. would start to complete vehicles with a coating of *Zimmerit* paste. Daimler-Benz would also commence the application of *Zimmerit* in October; Panther *Fgst.Nr.* 152035 was completed with full coat of *Zimmerit* paste on or about 30th October and was subsequently issued to I./Pz.Rgt. 1. The assembly plants involved in Panther production used several methods to increase the depth of the *Zimmerit* paste without the penalty of using more material to achieve this. The surface texture can often be used to identify the assembly plant that completed any Panther *Ausf*. A or *Ausf*. G that had a factory applied coating of this material.

The Panther *Ausführung* A "Elna" had several modifications completed by the unit *Werkstatt* who fabricated brackets for carrying spare Jerry cans and a spare wheel that were fitted over the armoured air intake castings on the engine deck. They also welded hooks to allow lengths of spare track to be carried on the Turm sides as additional armour. A handle was also welded to the loaders hatch in the *Turm* which can be seen in the photograph on page 63. This was one of several Panthers from I./Pz.Rgt. 6 that were lost on 11th July outside the hamlet of St. Fromond in Normandy during an engagement with M10 Tank Destroyers of the 899th Tank Destroyer Bn. who were supporting the U.S. 9th Inf.Div. (Eisenhower Archives via John LaTrobe)

APPLICATION AND TEXTURING OF *ZIMMERIT*

The application and texturing of *Zimmerit* was very consistent at M·A·N, the roller used to texture the surface left an evenly ridged pattern, only the areas that were difficult to access were finished with a trowel or float[1]. This finish was unique to those Panthers assembled by M·A·N although this method of application was also used by Henschel und Sohn on the Tiger series. The *Zimmerit* surface was then divided by an anti spall grid so that should an area become damaged the amount of *Zimmerit* that would be lost would be limited as far as possible by this grid and the shock would not be transferred through the material itself. M·A·N used a roller with ridges that left a series of ridges that were 12.5mm between centres running perpendicularly to the travel of the roller (the pitch of the roller used to texture the Tiger I and II series of vehicles is identical leading to the possibility that this was an officially approved method of texturing the surface of the *Zimmerit*). The roller texture added depth between the armour plate and surface of the *Zimmerit* as directed in the instructions for the application of *Zimmerit*. On the initial vehicles, the roller was run vertically so that the pattern looked like steps or a ladder running vertically up the armoured surfaces. Some sections of the vehicle were finished with a trowel or plasterers float as it was not possible to reach them with the roller either because this was too big and unwieldy, or if the assembly stage that might have allowed access with the roller had already been completed. An example of this would be after the exhaust stacks and brackets had been installed. The anti spall grid was scored vertically and horizontally into the surface effectively dividing the surface with a grid that would limit the shock transferred through the hardened paste to an area approximately 9 to 10cm square. This finish was short lived and appears to be limited to a very small number of vehicles assembled by M·A·N in September and possibly early October 1943. At the end of October 1943, M·A·N started to roll the surface of the *Zimmerit* horizontally. The application of the anti spall grid was quite consistent in that there are almost invariably seven horizontal scores leaving eight horizontal rows on the *Turm* sides. The vertical scores on the *Turm* sides were not always perpendicular; these would often be scored diagonally so that the grid was made up of rhomboids on a very high percentage of the Panthers assembled after October 1943. Photographic evidence confirms that the *Türme* at all of the assembly plants involved in Panther production had the *Zimmerit* applied before they were fitted to the *Fahrgestell*. Slightly different working practices between the two workstations may explain why this idiosyncrasy regarding the anti spall grid exists on M·A·N assembled Panthers. The *Zimmerit* past was applied to all of the vertical armoured surfaces that could be reached by a man

on the ground next to the tank including the larger sheet metal components such as the fenders and rear *Gepäckkasten* (stowage boxes) but excluding the gun cleaning tools tube. M·A·N continued to apply the *Zimmerit* coating in this manner until orders were received in September 1944 to discontinue the application of *Zimmerit* paste. Production of the *Ausführung* A at M·A·N only lasted for six months before assembly of the *Ausführung* G commenced in March 1944. A rake with with two tines or prongs was used to score the majority of the anti spall grid on Panthers completed by M·A·N as the majority of this grid is made up of groups of two parallel scores.

Opposite Page:
This Panther *Ausführung* A from I./Pz.Rgt. 6 shows the distinctive ridged surface texture on the *Zimmerit* anti magnetic paste applied to the Panthers assembled by the M·A·N plant Nürnberg. The surface was textured using a ridged roller that uniformly increased the distance from the surface of the *Zimmerit* to the armour plate using the minimum quantity of material. The *Zimmerit* surface was then divided by an anti spall grid so that should an area become damaged the amount of *Zimmerit* that would be lost would be limited as far as possible by this grid and the shock would not be transferred through the material itself to the surrounding area. The grid applied to the *Fahrgestell* was always square in appearance whereas the grid on the *Türme* frequently varied. The most common anti spall grid applied to *Türme was* square but it was also common to see a grid scored to have the appearance of either rhomboids or diamonds on Panthers completed by M·A·N. It was common practice at the M·A·N plant not to apply any *Zimmerit* paste between the frames of the forward tool stowage racks on the *Ausführung* A they completed. This Panther was lost in the vicinity of Saint-Lô on 19th July 1944 while I./Pz.Rgt. 6 were attached to the Pz.Lehr-Div during this divisions service in the Normandy campaign. (NARA via Darren Neely)

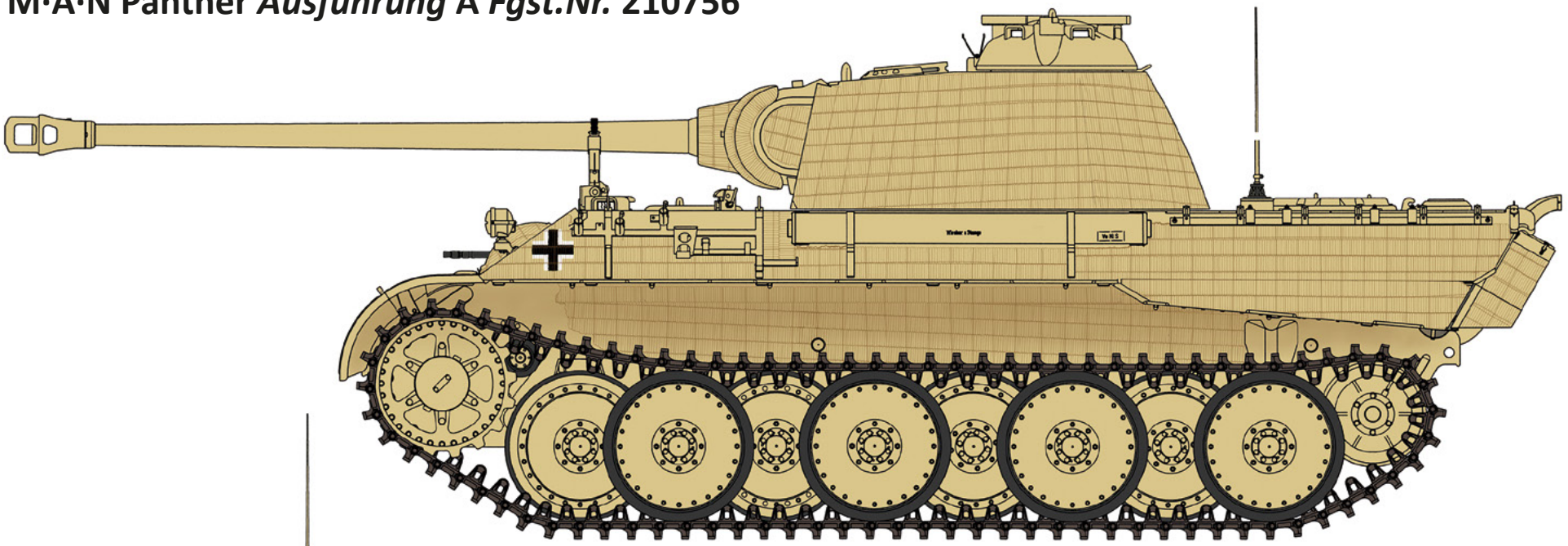
1 The method of application and achieving the finished texture was first established by Manus Gallagher in late 1999, this was extensively discussed on the internet site Missing Lynx and subsequently published in a magazine article.

191787

Panther *Ausführung* A *Fgst.Nr.* 210747 was completed by M·A·N on or about 13th February 1944. It was issued to 3./SS-Pz.Rgt. 1 and given the tactical number 328 which was painted on the side of the gun mantle, underneath the forward row of spare track hung on the Turm sides and repeated on the upper port corner of the *Turm* rear plate. The vehicle was abandoned during combat with Allied forces in the Mortain sector during the Normandy campaign. Following its capture it was shipped to Aberdeen Proving Ground in the United States for technical evaluation. This vehicle was until recently on public display in the Ordnance Museum at Aberdeen. Coincidentally, Panther *Fgst.Nr.* 152415 completed by Daimler-Benz on or about 23rd March 1944 and currently on display at Camp Borden in Canada is also a former 3./SS-Pz.Rgt. 1 vehicle from Normandy, it was assigned the tactical number 319. The damaged starboard side tool rack and front fender are still fitted to Panther *Fgst.Nr.* 210747. The *Turm* was manufactured by Eisenwerke Oberdonau who was sub contracted by the *Heeres-Waffenamt* to supply armoured components for the Panther. This has the rear edges of

the side armour cut parallel with the rear plate rather than perpendicular to the face of the armour plate. Note the bold camouflage scheme applied by the crew or unit Werkstatt using the acrylic paste concentrate issued with the vehicle. This appears to fade rapidly when applied over *Zimmerit* paste but retains its intensity when applied over sheet metal or armoured components. This Panther has the typical patched section of *Zimmerit* on the glacis plate where the boarding ladder used during assembly at M·A·N was mounted. It was fitted with two *Auspuffkühlung* pipes on either side of the main port side exhaust stack which drew cool air in around the manifold and poorly ventilated engine compartment, the previous design arrangement was prone to causing the gasoline in the fuel lines leading to the carburettors to evaporate and engine fires resulting from this. (2x NARA via Darren Neely)

M·A·N Panther *Ausführung* A *Fgst.Nr.* 210756



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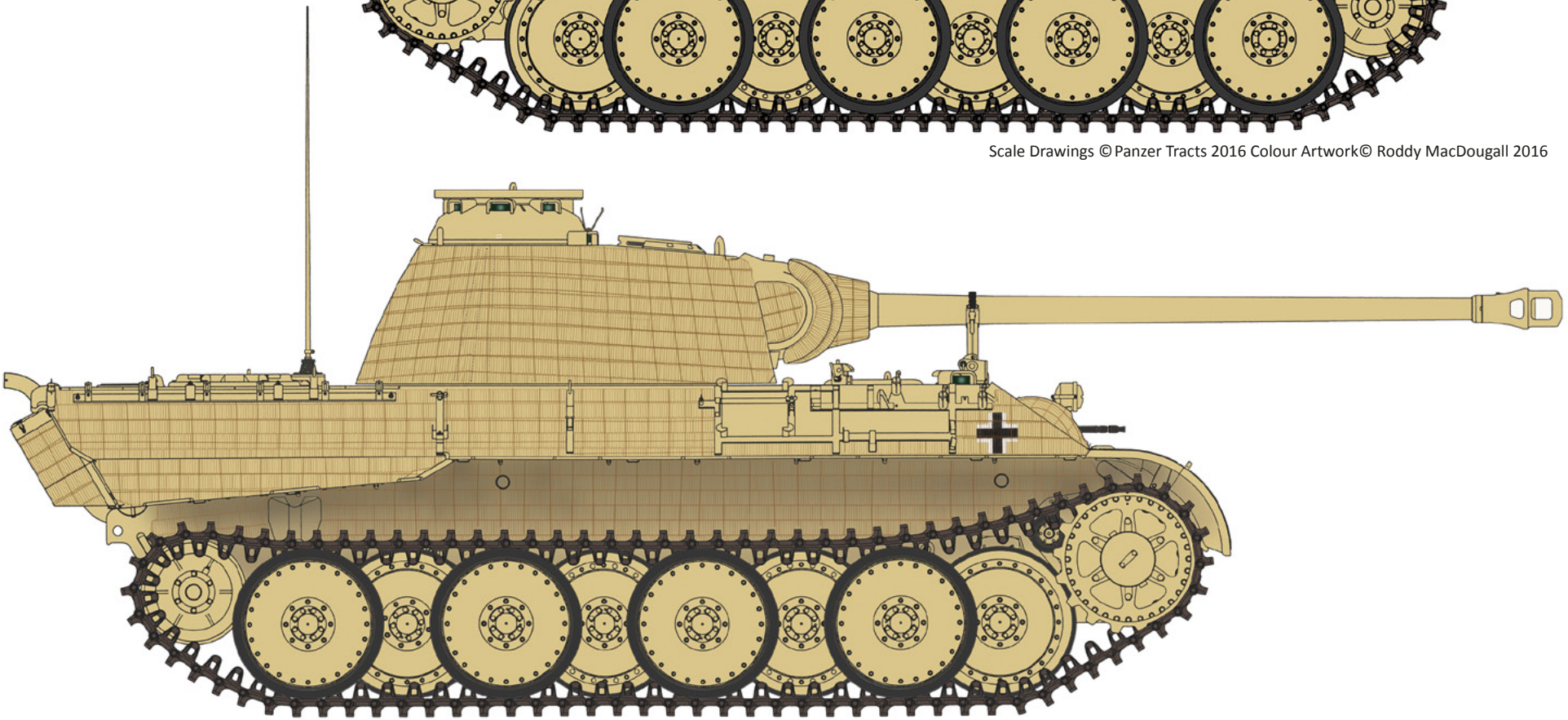

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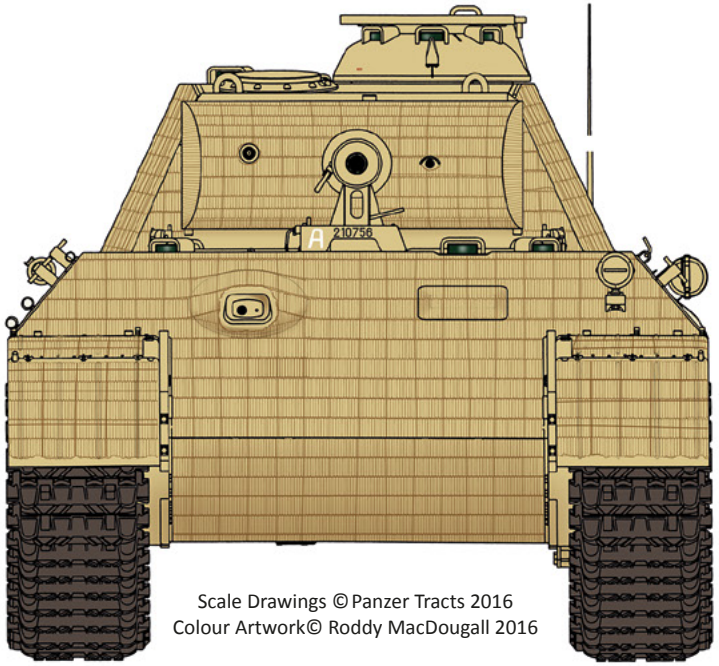

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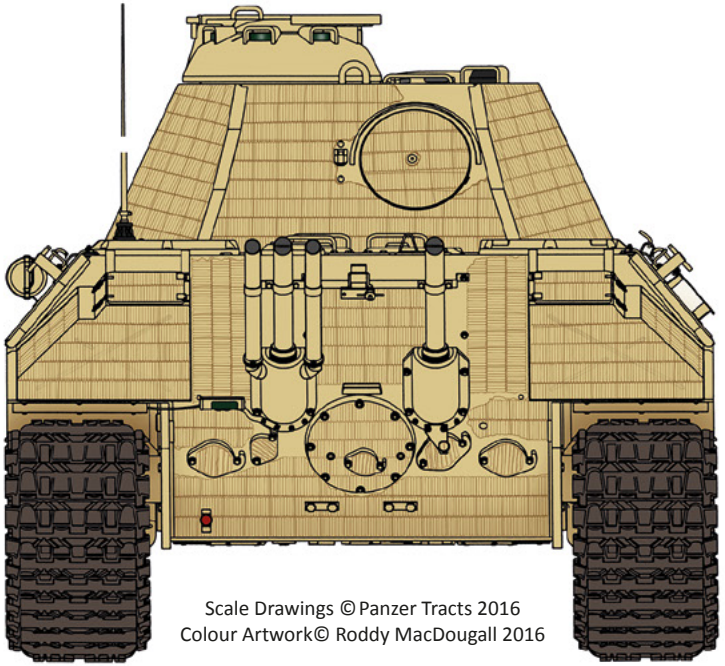

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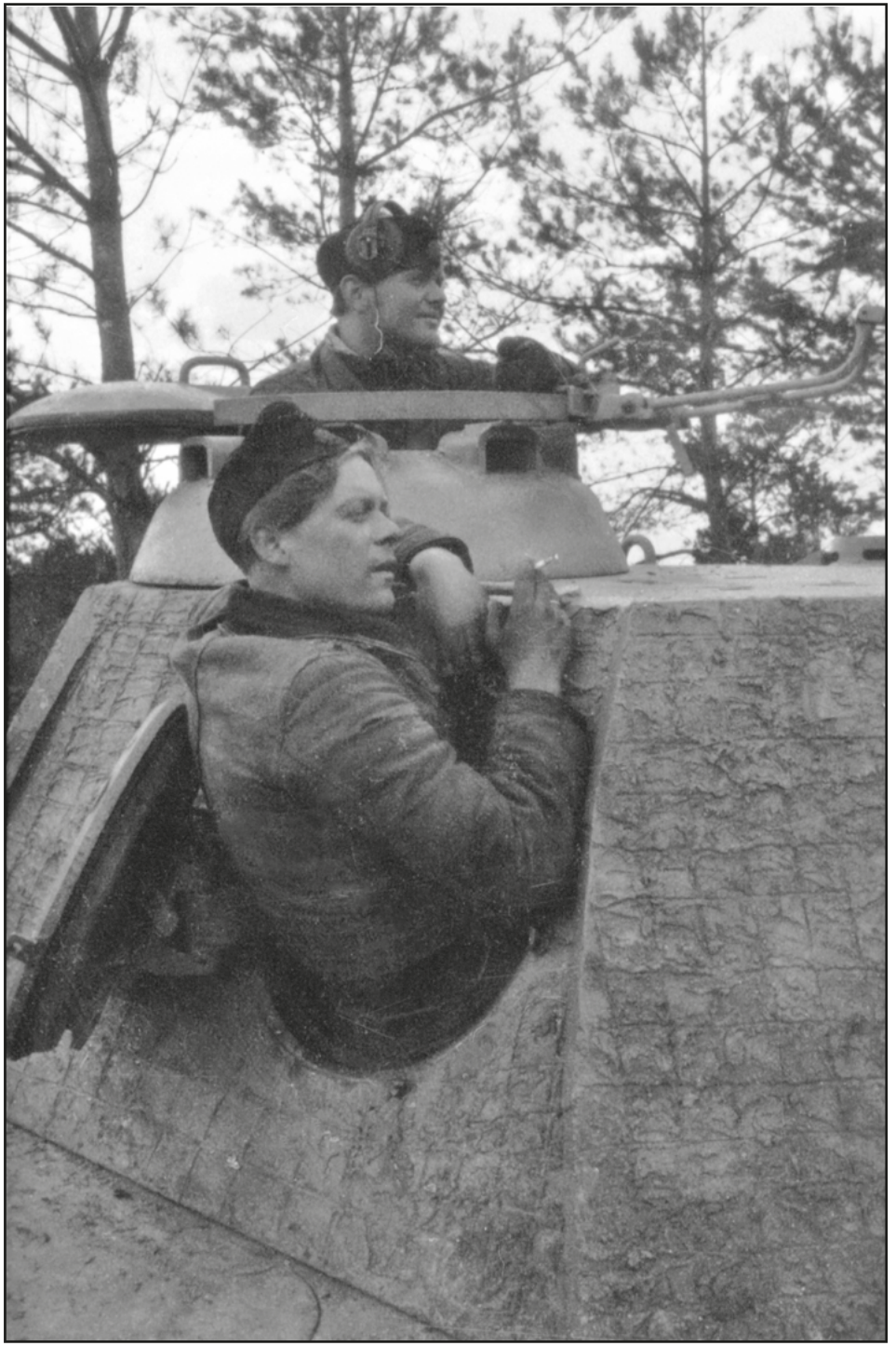
The application and texturing of *Zimmerit* was very consistent at M·A·N, the roller used to texture the surface left an evenly ridged pattern, only the areas that were difficult to access were finished with a trowel or float. M·A·N used a roller with ridges that left a series of ridges that were 12.5mm between centres running perpendicularly to the travel of the roller. The roller texture added depth between the armour plate and surface of the *Zimmerit* to increase the distance between the surface of the *Zimmerit* and the armour plate below this using the least amount of *Zimmerit* to achieve this as directed in the instructions for the application of *Zimmerit*. Some sections of the vehicle were finished with a trowel or plasterers float as it was not possible to reach them with the roller either because this was too big and unwieldy, or if the assembly stage that might have allowed access with the roller had already been completed. An example of this would be after the exhaust stacks and brackets had been installed. The anti spall grid was scored vertically and horizontally into the surface effectively dividing the surface with a grid that would limit the shock transferred through the hardened paste to an area approximately 9 to 10cm square. The application of the anti spall grid was quite consistent in that there are almost invariably seven horizontal scores leaving eight horizontal rows on the Turm sides. The vertical scores on the *Turm* sides were not always perpendicular; these could often be scored diagonally so that the grid was made up of rhomboids on a very high percentage of the Panthers assembled after October 1943. A small number of vehicles would have two opposing diagonal scores on the *Turm* anti spall grid without the vertical score so that the grid is made up of diamond shaped parallelograms. The anti spall grid scored into the *Zimmerit* surface on the *Fahrgestell* was always perpendicular. Photographic evidence confirms that the *Türme* at all of the assembly plants involved in Panther production had the *Zimmerit* applied before they were fitted to the *Fahrgestell*. Slightly different working practices between the two workstations may explain why this idiosyncrasy regarding the anti spall grid exists on M·A·N assembled Panthers. The *Zimmerit* paste was applied to all of the vertical armoured surfaces that could be reached by a man including the larger sheet metal components such as the fenders and rear *Gepäckkasten* but excluding the gun cleaning tools tube. M·A·N continued to apply the *Zimmerit* coating in this manner until orders were received in September 1944 to discontinue the application of *Zimmerit* paste.

This Panther *Ausführung* A from II./SS-Pz.Rgt. 5 has the armoured flap for an M.G. 34 machine gun in the glacis plate indicating it assembled between September and mid December 1943. It has the distinctive ridged surface texture on the *Zimmerit* anti magnetic paste applied to the Panthers assembled by the M·A·N plant Nürnberg. The surface was texture on the gun mantle using the same ridged roller that was used on the rest of the vehicle but rolled vertically rather than horizontally. The *Zimmerit* on the gun mantle has then been scored so that the anti spall grid has the appearance of rhomboids or diamonds rather than the rectangular grid scored into the *Zimmerit* on the *Turm* and *Fahrgestell*. There is no *Zimmerit* paste between the frames of the forward tool stowage racks on the *Ausführung* A. This Panther was finished in an overall coat of *Dunkelgelb* RAL 7028 and would be delivered with tins of *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 paste concentrate which could be mixed with a diluting agent to create camouflage patterns that are suitable for local conditions. It is photographed here with a coat of whitewash suitable for winter conditions. (Baumann)

DAIMLER-BENZ AND M.N.H.

APPLICATION AND TEXTURING OF *ZIMMERIT*

Daimler-Benz and M.N.H. did not apply *Zimmerit* to the initial *Ausführung* A Panthers they completed as the order to apply a coating of this material had not yet been received when assembly of the new design commenced. Two examples of vehicles delivered to the troops without a coating of *Zimmerit* paste are Panther *Fgst.Nr*. 151951 completed by Daimler-Benz on or about 1st October 1943 and Panther *Fgst. Nr.* 154810 completed by M.N.H. on or about 5th September 1943. M.N.H. would start to complete Panthers with a full coat of *Zimmerit* paste in late September followed by Daimler-Benz in mid *October*. The *Zimmerit* paste on Daimler-Benz and M.N.H. vehicles is characterised by a rough surface texture, an examination of surviving sections of *Zimmerit* and period photographs shows that this texture is proud of the surface rather than having been pressed into it by, for example, a stiff wire brush. There are however, some subtle differences that are apparent on a number of Daimler-Benz vehicles that can often be used to differentiate between the two. The rough textured surface layer was applied over the top of a smooth or slightly ridged foundation coat that was applied with a trowel or float. When present, the ridges in this base layer could be obscured by a heavy application of the textured surface layer. These ridges in the foundation layer were unique to Daimler-Benz vehicles but were not always present on all the vehicles assembled by them. Panther *Fgst.Nr.* 152228

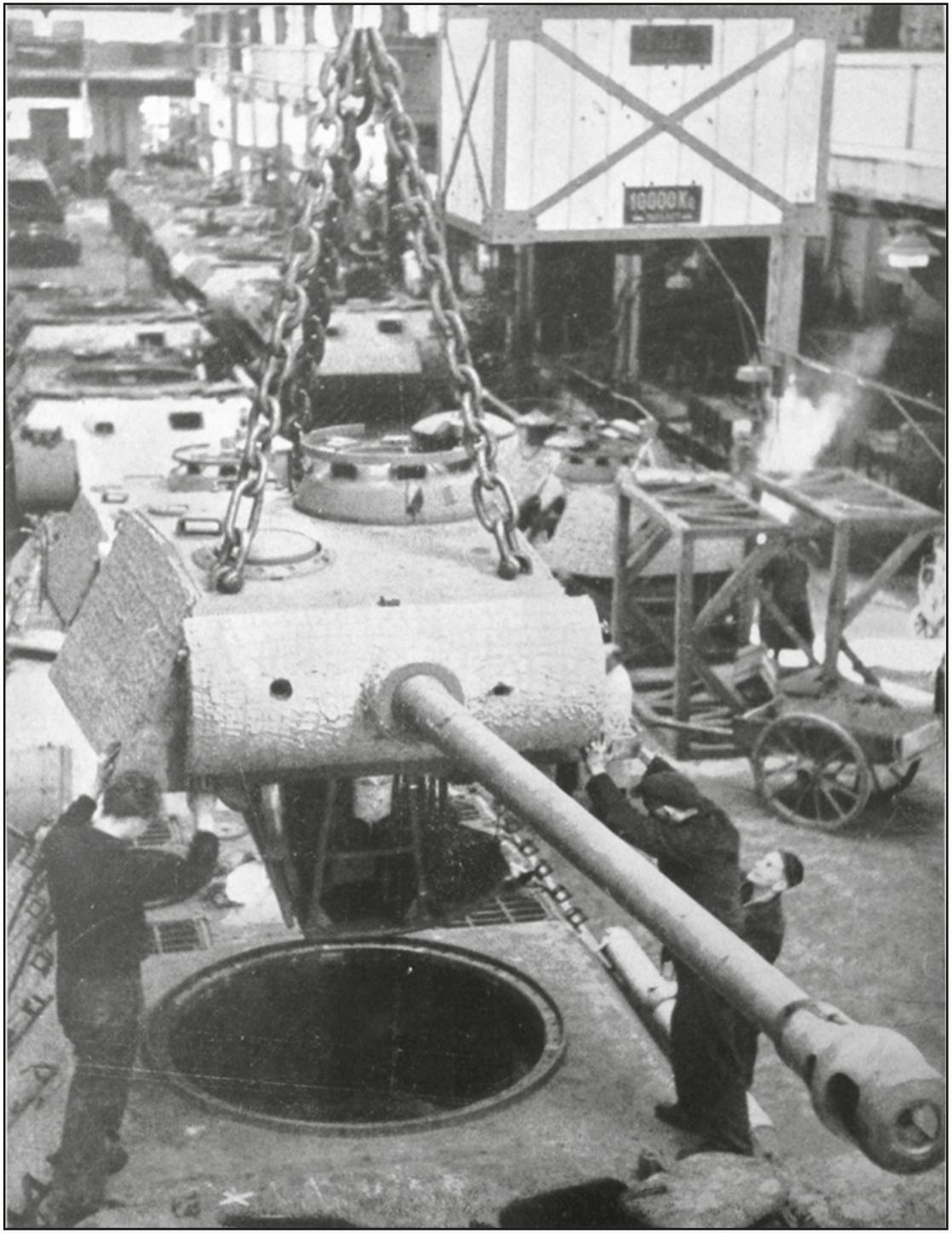


The rough surface texture on this Panther Ausf. A completed by Daimler-Benz was a layer applied over the top of a thin foundation coat that was spread with a trowel or float leaving diagonal ridges in the which can be seen through the second layer that provided the rough surface texture. The depth of the rough surface layer varied and it would often obliterate the ridges on the base layer of *Zimmerit* beneath it. The ridged texture on the foundation coat is unique to Panthers completed by Daimler-Benz, this could be obscured or was not always present on the Panthers completed by Daimler-Benz. As both Daimler-Benz and M.N.H. used similar methods to apply the rough textured surface coat and anti spall grids with varying dimensions, it can be very difficult to determine which of these assembly plants completed a particular Panther in period photographs if the ridges are not visible. The anti spall grid scored into the surface by Daimler-Benz is typically 7cm, however this can vary from vehicle to vehicle from around 5cm to 10cm. Original *Zimmerit* paste with a similar rough surface texture and an anti spall grid that averages 8cm can be found on a surviving Panther assembled by M.N.H. on or around 4th March 1944. The Panther shown in this photograph was issued to *II./SS-Pz.Rgt. 5* and was photographed in service in the Ukraine in 1944. (NARA via Darren Neely)

This well known photograph of a Panther from I./Pz.Rgt. GD is an excellent example of how difficult it is to determine whether Daimler-Benz or M.N.H completed any given Panther based on the appearance of the *Zimmerit* paste. This Panther has an anti spall grid at the smaller end of the scale and the rough surface texture that was typically only associated with Panthers completed by Daimler-Benz. A thorough examination of surviving Panthers and period photographs confirms that this is not the case as this combination of surface texture and the size of the anti spall grid can also be found on Panthers completed by M.N.H. Without a visible *Fahrgestell* number or visible ridging present in the *Zimmerit* foundation coat it is impossible to determine the assembly plant by these features alone. (Atlantic Press Bilderdienst)

completed by Daimler-Benz on or around 13th January 1944 does not have these ridges. This Panther is on display at Sinsheim complete with its original *Zimmerit*. The base coat of *Zimmerit* on Panthers assembled by M.N.H. was smooth with little or no texture. If the ridged texture on the foundation coat of a Daimler-Benz Panther has been obscured or was not present, it can be very difficult to differentiate between Daimler-Benz and M.N.H. Panthers based on the appearance of the *Zimmerit* alone as both assembly firms would texture the exposed surface layer using similar methods. This would be the case for a period of time during series production of the *Ausführung* A. These ridges would not be present on all of the *Ausführung* A Panthers assembled by Daimler-Benz until shortly before they switched over to production of the *Ausführung* G. This underlying pattern was more prominent on the *Ausführung* G Panthers completed by Daimler-Benz until *Zimmerit* was discontinued in September 1944. The application of *Zimmerit* by both Daimler-Benz and M.N.H. often included a coating on the cupola, there does not appear to be a particular reason why some vehicles had *Zimmerit* applied to the cupola and some did not, it can be found on vehicles assembled in different months alongside vehicles that did not have this coating on the cupola that were assembled in the same time frames. Panther *Fgst.Nr.* 152064 assembled by Daimler-Benz in November 1943 has a full coating of *Zimmerit* paste that also covers the commander's cupola; this Panther underwent comparison trials with other Panzers at Grafenwöhr where it was extensively photographed. Daimler-Benz would cover all of the exposed vertical armour plates with *Zimmerit* including the edges of the plates on a number of the *Ausführung* A Panthers they completed in 1943. There is also a *Zimmerit* coating on the commander's cupola of Panther *Fgst. Nr.* 155597 completed by M.N.H. on or around 25th June 1944.

Both assembly firms would then score an anti spall grid into the surface, the dimensions of this grid varied considerably with anything



This photograph taken inside Daimler-Benz Werke 40 at Berlin, Marienfelde in late 1943 showing *Türme* being mounted on *Fahrgestell* that have completed their initial 15km test run. Both the *Türme* and *Fahrgestell* have been given a coating of *Zimmerit* paste during the early stages of their assembly as separate sub assemblies. The diagonal ridges can clearly be made out despite the poor quality of the paper the original photograph was printed on. Note that the *Turm* suspended from the overhead gantry crane has a monocular T.Z.F. 12a gunsight fitted and that the gun cleaning tools tube on the Port side of the *Wanne* has the early pattern mounting brackets as used on the *Ausführung* D. (Hartmann ZFNWP)

between 5cm and 10cm sections of *Zimmerit*. The dimensions of this grid have been considered a positive indication of a Daimler-Benz assembled Panther. However, this is not the case as M.N.H. also assembled Panthers that had the *Zimmerit* paste finished in the same textured pattern and using similarly sized anti spall grids scored into the surface. Panther *Fgst.Nr.* 155209, completed by M.N.H. on or about 4th March 1944 still has part of its original coating which has an identical texture to Panther *Fgst.Nr.* 152158 completed by Daimler-Benz around 18th December 1943 and issued to I./Pz.Rgt. 6, this is apparent in the photographs taken during its examination at Aberdeen Proving Ground following its capture. Both Daimler-Benz and M.N.H. completed Panthers with a textured surface where there are no ridges apparent on the base coat beneath this. They also applied anti spall grids with varying dimensions making them very difficult to tell apart in period photos. M.N.H. did use a second pattern on a number of *Ausführung* A Panthers that they assembled. This pattern was finished with a trowel or float leaving a smooth surface with little or no rippling or texture on the surface. This had an anti spall grid that was approximately 5 to 10cm² scored into the surface. One of the vehicles completed by M.N.H. with this pattern was Panther *Fgst.Nr.* 155409 completed in early May 1944 and issued to I./Pz.Rgt. 24. This method of application was not particularly efficient in that the volume of material used would need to be significantly increased to achieve a similar distance from the surface of the *Zimmerit* to the armour plate as would have been the case by using one of the other methods of application and texturing.

It is difficult not to conclude that the methods chosen by the various assembly firms for the application of *Zimmerit* were rooted in the building industry where the efficient application of plaster, render and stucco was commonplace. This has led to an examination of the possible methods that could be used to apply the very efficient textured surface that uniformly increased the distance from the surface of the *Zimmerit* to the armour below using as little material as possible. The methods that are most efficient are found in the application of render or roughcast. Given the properties of *Zimmerit* and following practical experimentation with various methods of replicating this finish, it seems likely that a Tyrolean flicker gun or similar tool was used. This tool consists of a reservoir, a hand crank attached to a spindle with comb like wires and a tension bar to adjust the volume of material and the amount of splatter. The wires scoop the material from the reservoir as the handle is cranked; this flicks small splotches very consistently and efficiently on to the surface to be coated. There are other methods of achieving this finish but most involve the use of a comb that is manually used to pick up material from a reservoir and flick it on to the surface to be coated. This latter method requires some skill on the part of the worker to ensure an even and efficient application of material while the Tyrolean flicker gun requires less.

Panthers undergoing the final stages of assembly at the Daimler-Benz plant at Berlin, Marienfelde in late 1943. The vehicles have been given a coating of *Zimmerit* paste during the early stages of their production as separate sub assemblies but have still to receive a coat of *Dunkelgelb* RAL 7028. Some of the ridging can be made out but this photograph illustrates the difficulty of determining whether this is present or not. (Hartmann ZFNWP)

The introduction of *Zimmerit* paste on armoured vehicles initially baffled the Allies. Various theories were proposed as to its intended purpose ranging from an additional armoured component to a form of camouflage. The latter theory is interesting as it was noted that the rough surface was not at all reflective. Vehicles in service in Italy where the coating was first encountered by the Western Allies quickly became covered in a layer of dust that blended with the surrounding terrain, considerably enhancing the vehicle's camouflage. Another interesting phenomenon regarding *Zimmerit* can be observed by examining period photographs. The paints used to apply tactical numbers and the camouflage paste concentrate are gradually absorbed over time by the *Zimmerit*. Vehicles that have been knocked out where a large section of *Zimmerit* has spalled off the *Turm* armour frequently reveal the tactical numbers applied to the surface of the *Zimmerit* paste have bled through to the undercoat.

The last Panther *Ausführung* A completed by Daimler-Benz was Panther *Fgst.Nr.* 152575 photographed above after being knocked out at Épinal, Vosges, France on 24th September 1944. It had been issued to I./Pz.Rgt. 29 who were then attached to Pz.Brig.112 who in turn were attached to *Kampfgruppe* Von Luck from 21.Pz.Div. The ridges in the *Zimmerit* paste can clearly be made out on the rear quarter of the *Turm* and the starboard corner of the lower glacis plate. A debris guard has been fitted over the gun mantle, this is unusual as Daimler-Benz would not start to complete *Ausführung* G Panthers with this feature until August 1944, it was possibly retro fitted by the unit *Werkstatt*. The *Fahrgestell* number 152575 is stencilled in black on the gun travel lock. This Panther would eventually be recovered by Free French Forces and returned to service with the French Army after the war. It is currently in storage in serviceable condition at the Musée des Blindés at Saumur. (Lee Archer)

The majority of the Panthers from I./Pz.Rgt. 6 that formed part of the armoured element of *Kampfgruppe* Hennecke that entered the centre of Paris were a mixture of new *Ausführung* G completed by Daimler-Benz and *Ausführung* A completed by M.N.H. in June 1944. This particular Panther was knocked out by M4 Sherman tanks from 2 Cie 501e RCC on Rue de Vaugirard during the battle for Paris. It is finished in an overall coat of *Dunkelgelb* RAL 7028 and is devoid of any unit or tactical markings. The cupola has been given a coating of *Zimmerit* paste along with all of the vertical armour and large sheet metal components. This has a rough textured surface as well as an anti spall grid that is at the smaller end of the 5 to 10cm² scale typically used. The smaller anti spall grid and rough surface texture has previously

been erroneously attributed exclusively to Panthers completed by Daimler-Benz. This is not the case as can be seen on the photographs showing original *Zimmerit* still present on the sides of the Fahrgestell of Panther *FgstNr.* 155209, completed by M.N.H on or about 4th March 1944. The smooth foundation coat can be seen underneath the secondary coat that provided the rough surface texture. This texture stands proud of the surface and can not be achieved by pressing a tool into the surface. The anti spall grid scored into the Zimmerit averages 8cm² so that the size of the anti spall grid and rough surface texture can not be used to differentiate between Panthers assembled by Daimler-Benz or M.N.H. (1 x Lee Archer and 2 x Roddy MacDougall)

DEMAG

APPLICATION AND TEXTURING OF *ZIMMERIT*

The introduction of the *Ausführung* A saw the inclusion of the assembly firm Demag to production of the Panther series. This company already had extensive experience of working on the Panther at its Berlin Albrechtshof premises where it carried out remedial work on the *Ausführung* D. They had delivered their first eight new vehicles by the end of September 1943 and had chosen a different method for increasing the distance between the surface of the *Zimmerit* paste and the armour. Panthers delivered by Demag had a very distinctive ridged pattern made with a tool similar to a plasterer's trowel or float. The pattern was not a simple series of ridges created with the trowel or float using linear movements; it resembled a grammatical brace bracket in profile where the ridge was formed in the centre of the vertical movement of the trowel "{". There could also be a raised section in the middle of the ridge, the trowel having a small notch or groove in its edge could possibly have caused this, however, this is not always visible on all of the Demag assembled vehicles. Demag ceased production of the *Sd.Kfz.* 171 Panther after assembling fifty of these vehicles to allow them to concentrate on assembly of the *Sd.Kfz.* 179 Bergepanzerwagen or Bergepanther in January 1944, they continued to use the same method of *Zimmerit* application on these vehicles as they had on the Panther. Unusually, Demag did not score an anti spall grid into the surface of the *Zimmerit*, they were the only assembly plant involved in Panther production that did not do this. Demag did not assemble any Panthers with a *Kugelblende* ball mount for the glacis mounted MG.34 machine gun or the modified exhaust stack with two *Auspuffkühlung* pipes as this design change was introduced to production in January 1944 after Demag had moved over to assembly of the Bergepanther. Demag would cover all of the exposed vertical armour plates with *Zimmerit* including the edges of the plates on all of the Panthers they completed. Demag would complete a small number of its *Ausführung* A Panthers fitted with the armoured cover for the submersion equipment on the engine deck[1].

The majority of the *Wannen* fabricated for *Ausf*. A production had holes for fitting the centrally mounted bolted tow coupling, a small number of the Panthers assembled by Demag in November and December 1943 had this tow coupling fitted. There is no evidence that this part was ever installed on Panthers by any of the other assembly firms who plugged the mounting apertures with bolts and steel plates. The sheet metal spare track brackets on the rear of the Panther's *Wanne* were held in place by four bolts screwed into the engine deck on Panther *Ausführung* D and A assembled by M·A·N, Henschel, M.N.H, Daimler-Benz as well as Demag. The extremely high temperatures generated by the welding process had a detrimental effect on the face hardening process. This was one of the steps taken to reduce the number of components that the assembly plants welded to the face hardened sections of armour plate on the *Wanne*. The spare track brackets would be welded to the *Wanne* sides by Demag when they started to assemble Bergepanthers, this method of fixing these brackets would later be adopted on the *Ausführung* G by all of the assembly plants involved in its assembly. The relatively small number of Panthers assembled by Demag that were issued to units who fought against the Western Allies were I./Pz.Rgt. 6 who were attached to the Pz.Lehr-Division in Normandy, I./Pz.Rgt. 3 had at least one Panther *Ausf.* A completed by Demag that was knocked out or abandoned at Briouze in Normandy[2], I./SS-Pz.Rgt. 9 who also fought in Normandy, I./Pz.Rgt. 4 who fought in Italy and at least one rebuilt vehicle was also reissued to Pz.Abt.2106. Demag assembled Panthers were also issued to I./Pz.Rgt. 31, II./Pz.Rgt. 23, I./Pz.Rgt. 11 and I./Pz.Rgt. 1 who all fought on the Eastern front.

1 Panther *Fgst.Nr.* 158134 was fitted with this armoured cover when captured by Allied forces in Normandy.

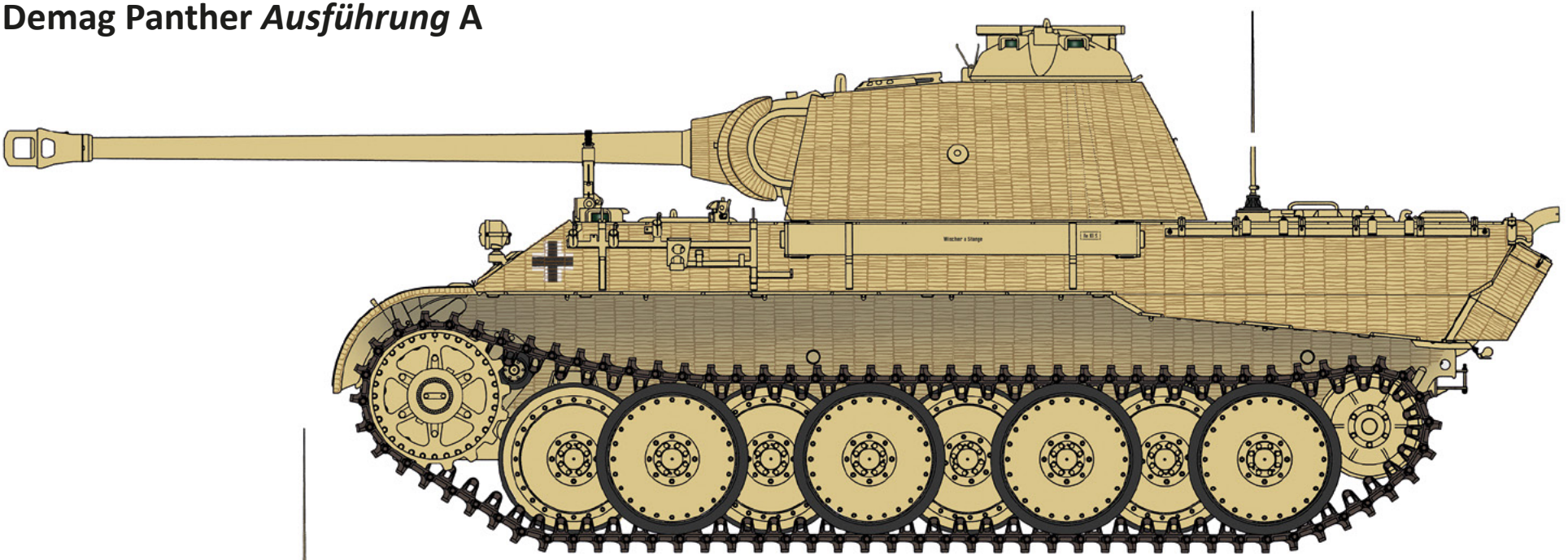
2 This vehicle has been renumbered; the vehicle's original tactical number 231 is much larger than the second number I02 painted directly over the old number. The original number is closer in size and appearance to those used by I./Pz.Rgt. 6 in Normandy.

Opposite Page:
This Panther *Fgst.Nr.* 158134 was completed by Demag on or about 1st December 1943 and has received a full coating of *Zimmerit* paste on all of the exposed vertical armour and sheet metal surfaces as was the practice at Demag. It is amongst the last vehicles to be fitted with an armoured cover for the *Schnorchel* deep wading equipment on its engine deck. The vehicle is pictured outside Briouze in Normandy shortly after its capture by U.S. forces from I./Pz.Rgt. 3. Note that the spare track brackets on the rear of the *Fahrgestell* are bolted to the engine deck. Following its capture this Panther would be repaired and returned to service with Free French forces, it was during the course of these repairs that the spare track brackets were welded to the Fahrgestell sides. This Panther also has another common modification to the stowage brackets for the 20ton jack, the brackets that normally allowed the jack to be stowed horizontally underneath the armoured exhaust elbows have been modified and welded to the *Fahrgestell* rear plate to allow the jack to be stowed vertically between the vehicles exhaust stacks. This modification was completed at the assembly plants until the drawings for the redesigned tool stowage bracket were completed by M·A·N. (NARA via Darren Neely)

Panthers completed by Demag had a very distinctive ridged pattern made with a tool similar to a plasterer's trowel or float. The pattern was not a simple series of ridges created with the trowel or float using linear movements; it resembled a grammatical brace bracket in profile where the ridge was formed in the centre of the vertical movement of the trowel. There could also be a raised section in the middle of the ridge, the trowel having a small notch or groove in its edge could possibly have caused this, however, this is not always visible on all of the Demag assembled vehicles. There was no anti spall grid cut into the Zimmerit on the Panthers that Demag completed. Demag would continue to use the same tools and methods to apply Zimmerit to the Bergepanthers when they started to assemble this vehicle in January 1944. This Panther from I./Pz.Rgt. 4 was captured by Allied forces in the vicinity of San Giovanni Incarcico in Italy's Lazio province around the 25th May 1944. Note the bolted tow coupling that was unique to Demag assembled Panthers. (NARA via Darren Neely)

This Demag assembled Panther from I./Pz.Rgt. 31 was captured more or less intact by Soviet forces at Uman in the Ukraine. The coating of *Zimmerit* paste is very thorough extending to the edges of the armour plate as well as the area above the tool racks. The tool racks themselves have been unbolted and stowed on the engine deck, these racks would not be welded in place by Demag until they had stopped production of the Panther *Ausführung* A to take over production of the Bergepanther. The unit *Werkstatt* have welded a handle on the loader's hatch in the *Turm*, this was a common modification as it was difficult to open and close without this addition particularly in winter when the crew would be wearing thick gloves. They have alse fabricated Jerry can racks which are welded to the inner faces of the *Gepäckkasten*. (RGAKFD via Lee Archer)

Demag Panther *Ausführung* A



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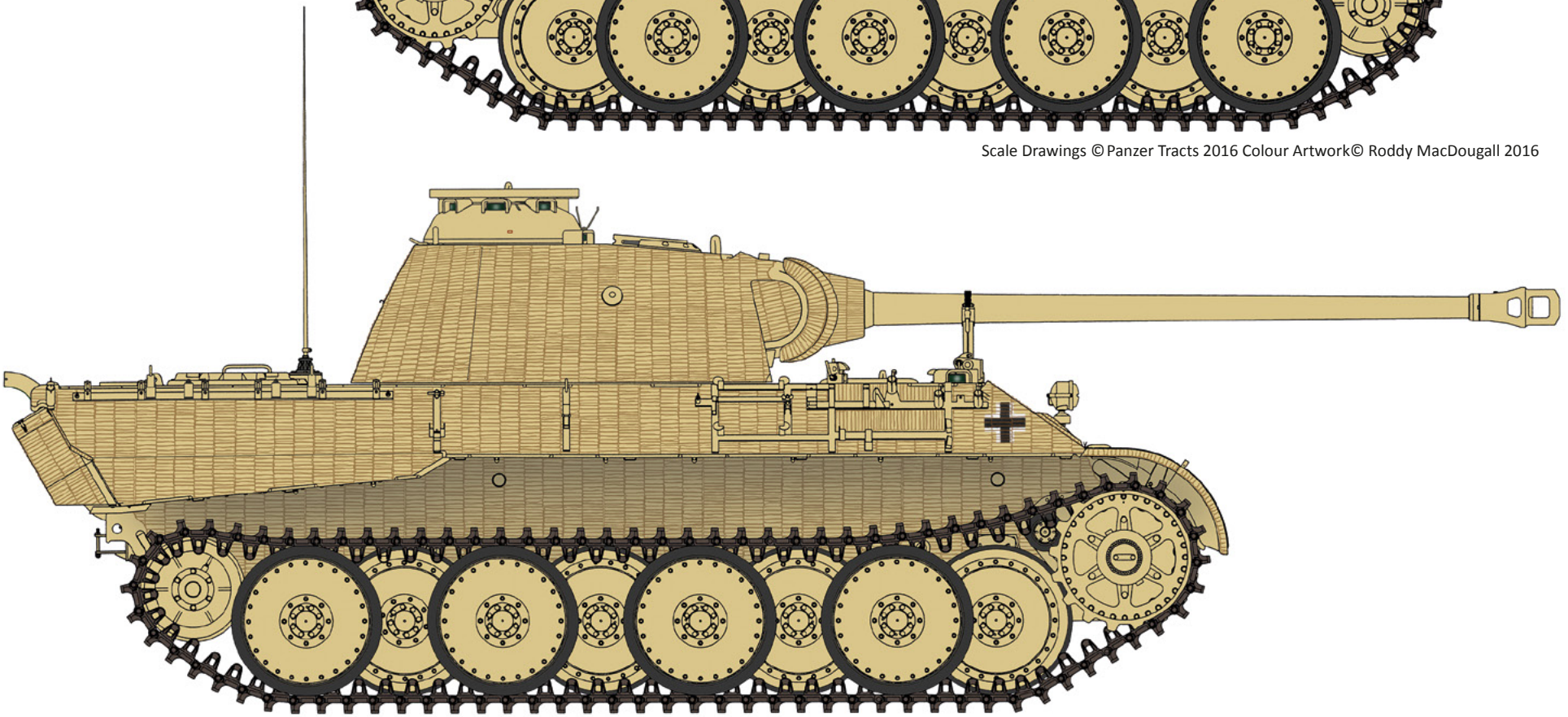

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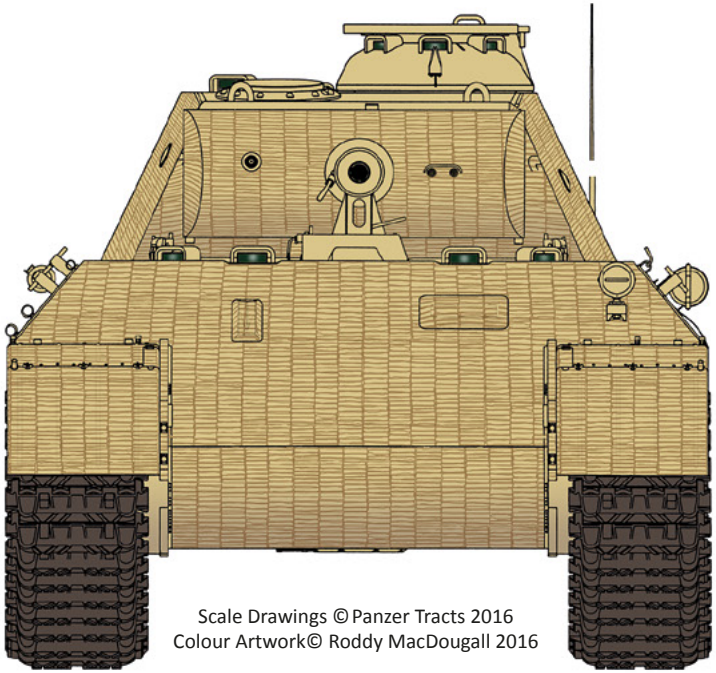

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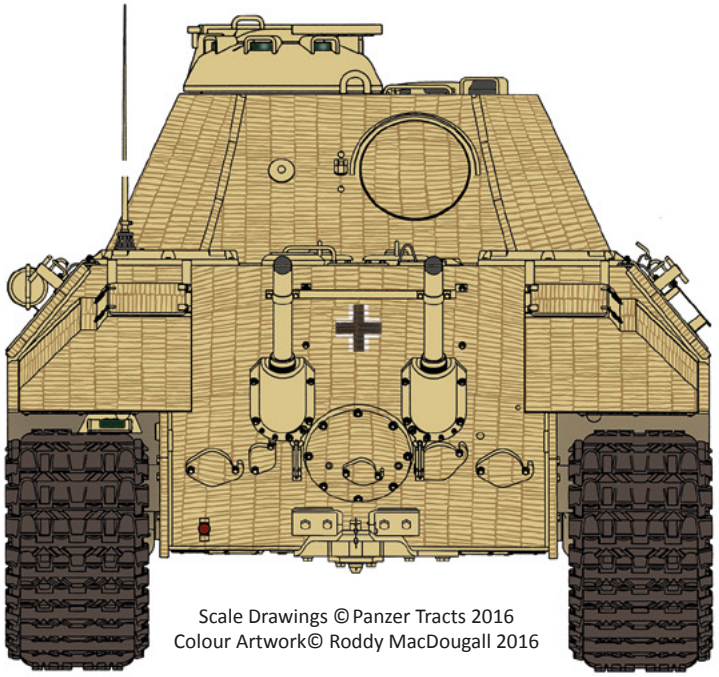

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The introduction of the *Ausführung* A saw the inclusion of the assembly firm Demag to production of the Panther series. This company started series production of the Panther *Ausführung* A at its Berlin, Albrechtshof premises in September 1943. They had chosen a different method for increasing the distance between the surface of the *Zimmerit* paste and the armour. Panthers delivered by Demag had a very distinctive ridged pattern made with a spatula tool similar to a plasterer's trowel or float. The pattern was not a simple series of ridges created with the trowel or float using linear movements; it resembled a grammatical brace bracket in profile where the ridge was formed in the centre of the vertical movement of the trowel. There could also occasionally be a raised section in the middle of the ridge, this could possibly have been caused by a small notch or groove in the edge of the trowel or spatula, however, this is not visible on all of the Demag assembled vehicles. All of the exposed vertical armour and sheet metal surfaces would receive a coating including the exposed armour above the spare track brackets on the *Fahrgestell* and the edges of the armour plates. None of the Demag assembled Panthers would have an anti spall grid scored into the surface of the *Zimmerit*, they were the only assembly plant involved in Panther production that did not do this. Demag did not assemble any Panthers with a *Kugelblende* ball mount for the glacis mounted MG.34 machine gun or the modified exhaust stack with two *Auspuffkühlung* pipes as this design change was introduced to production in January 1944 after Demag had moved over to assembly of the Bergepanther. Demag would complete a small number of its *Ausführung* A Panthers fitted with the armoured cover for the submersion equipment on the engine. A design feature unique to Demag assembled Panthers was the centred tow coupling mounted on the lower edge of the rear *Fahrgestell* plate. The spare track brackets on the Fahrgestell were fabricated using the original design that were bolted to the engine deck as used by all of the assembly firms since the beginning of *Ausführung* D series production.

Evolution of the *Ausführung* A

M.N.H. was the first assembly plant to switch over to the *Ausführung* A completing its first three Panthers in August 1943, Daimler-Benz, Demag and M·A·N would complete their first *Ausführung* A Panthers in September 1943.

The initial *Ausführung* A Panthers assembled by M·A·N were fitted with the older "drum" shaped cupola complete with a ring for the *Fliegerbeschussgerät* (anti aircraft mount for the MG.34) carried over from the *Ausführung* D. This has led to some confusion in identifying whether a vehicle is an *Ausführung* D or and *Ausführung* A as the assumption was made that if the vehicle had the older cupola it must be the *Ausführung* D. The other assembly plants, which now included Demag who had replaced Henschel in order to allow Henschel to concentrate on other projects, fitted the new cast design with seven periscopes which was officially introduced to production on 1st August 1943 and can be seen fitted to at least one Panther Pz.Bef. Wg. *Ausführung* D issued to Pz.Rgt. 1[1].

Neither M.N.H. or Daimler-Benz delivered the initial vehicles that they assembled in September with a coat of *Zimmerit* paste or a ring for the *Fliegerbeschussgerät* welded to the cupola. Daimler-Benz would not start to apply a coat of *Zimmerit* paste until well in to October 1943. Another idiosyncrasy of a number of the initial Daimler-Benz *Ausführung* A Panthers was the steel plate bump stop intended to limit how far the commander's hatch would open on the new cast commander's cupola. This had a considerably shorter steel base plate than those installed by the other assembly firms[2]. The new cast cupolas were fabricated by sub contractors and it seems that this shortened bump stop was limited to one sub contractor who delivered new cast cupolas exclusively to Daimler-Benz. This design variation would be seen on Daimler-Benz assembled vehicles completed up to late November. A new simplified *Deckel* (armoured hub cap) that consisted of a single piece 315mm diameter armoured plate secured using the two bolts, this had a sheet metal locking tab similar to that used on the Panther *Ausf*. D, started to appear on Panthers completed in late September. This would completely replace the older design on new vehicles within a few weeks.

There was a transition period during which time a small number of the new *Türme* delivered still had the dovetailed armour interlock between the trunnion armour casting and the *Turm* sides. This is not visible in period photographs as almost all of the new *Ausf.* A Panthers were delivered to the troops with a coating of *Zimmerit* anti magnetic paste introduced to defeat enemy infantry armed with magnetic mines. Pistol ports with armoured plugs were also provided in the new *Turm* for close defence; these would eventually be deleted from production as the aperture had a detrimental effect on the ballistic integrity of the armour. *Türme* fabricated by Eisenwerke Oberdonau in Linz can be identified by the angle of the cut edges on the sides where they overlap the rear plate; these are cut parallel to the rear plate rather than being cut perpendicular to the armour face. Eisenwerke Oberdonau would continue to fit the welded pattern of *Turm* ventilator armour cover following the introduction of the forged armoured cover by the other armour manufacturers. The three letter manufacturers code kmy can frequently be found on the front plate/ trunnion armour casting of *Türme* produced by this company.

There are only five major external design modifications over the production life of the *Ausführung A* that are readily visible in period photographs. The first of these was the introduction of the *Kugelblende* ball mount for the glacis mounted MG.34 machine gun between late November and late December 1943. The second periscope in the *Wanne* roof was deleted at the same time as the MG.34 would have interfered with its use and the gun sight for the MG.34 now provided forward vision for the crewman. This replaced the rectangular aperture and hinged armoured M·A·N cover design that was present on the original design for the *Wanne*. The transition to the new design was driven by the delivery of *Wannen* fitted with a *Kugelblende*, Daimler-Benz completed *Fgst.Nr.* 152156[3] on or about 17th December 1943 with the armoured flap for the glacis mounted MG.34 while *Fgst.Nr.* 152158[4] was completed around a day later and has the *Kugelblende* ball mount. Panther *Fgst.Nr.* 210530 was completed with an armoured flap by M·A·N on 14th December 1943, Panther *Fgst.Nr.* 210536 was completed with a *Kugelblende* two days later on 16th December 1943[5]. The new T.Z.F. 12a monocular gunsight was also introduced around the same time. M·A·N completed *Fgst.Nr.* 210506 on or about 7th December with the new gunsight fitted[6]. The introduction of straight joints in the *Wanne* roof was only implemented by some of the armour manufacturers. *Wannen* with interlocked roofs continued to be manufactured and delivered to the assembly plants alongside those with straight joints[7]. The straight cut roof was an accepted alternative to the interlocked roof and did not replace this. This appears to have caused some confusion where the presence of an interlocked *Wanne* roof has been described as an early feature, this is not correct as this feature could be found throughout the production of the *Ausführung* A series.

The pistol ports in the sides and rear plate of the *Türme* were replaced with a roof mounted *Nahverteidigungswaffe*. It was intended that this new weapon would be

1 Scheibert: *Panther Im Einsatz 1943-1945* (Waffen-Arsenal Sonderband 24).

2 Panther *Fgst.Nr.* 152063 completed on or about 10th November 1943 is fitted with a shortened bump stop plate.

3 Panther *Fgst.Nr.* 152156 issued to I./Pz.Rgt. 26 and photographed at Aschaffenburg..

4 Panther *Fgst.Nr.* 152158 issued to 2./Pz.Rgt. 6 and shipped to Aberdeen Proving Ground for evaluation after captured in Normandy.

5 Panther *Fgst.Nr.* 210530 was completed by M·A·N around 14th December 1943 and is currently on display at Thun in Switzerland. Panther *Fgst.Nr.* 210536 photographed on 23rd June 1944.

6 This Panther was fitted with the third T.Z.F. 12a gunsight (serial number 42003) completed, it is not known if the first two sights were also issued to M·A·N. Also see: Jentz and Doyle: *Germany's Panther Tank, The Quest for Combat Supremacy*.

7 Jentz and Doyle: *Panzer Tracts No.5-2 Panzerkampfwagen Panther Ausf. A*.

Panther *Ausführung* A *Fgst.Nr.* 152151 was completed by Daimler-Benz on or around 16th December 1943 with a full coating of *Zimmerit* anti magnetic paste. The *Fahrgestell* has an armoured flap for in the glacis plate for the M.G.34, this is the same design as that used for the last *Ausführung* D. This would be one of the last Panthers known to be completed by Daimler-Benz with this design feature would be replaced with the *Kugelblende* (armoured ball mount) by the armour manufacturers in late 1944. This new design feature was present on the *Wanne* used for Panther Fgst.Nr. 152158 which was completed two days later on or around 18th December 1943. The vehicles *Fahrgestell* number can be seen stencilled in black on the gun travel lock, this was common practice amongst all of the plants involved in assembly of the Panther series at that time. The tracks are the redesigned Kgs64/660/150 caterpillar tracks with the 6 *Gleitschutzpickeln* chevrons on the grouser faces. (Bundesarchiv 101I-664-6759-30)

introduced in December 1943 however, due to shortages the aperture was often covered with a circular bolted plate until sufficient quantities of this weapon to equip all of the vehicles being assembled became available in April 1944. There was a period of a few weeks as the armour manufacturers switched over to the new design. There were still *Türme* with pistol ports in the process of being assembled when the first *Türme* without pistol ports and a roof aperture for the *Nahverteidigungswaffe* was introduced so that these can be still be seen on Panthers that were fitted with a *Kugelblende* and had straight cut roof plates. There were also a small number of *Türme* delivered from the armour manufacturers that were devoid of either pistol ports or an aperture in the roof for the *Nahverteidigungswaffe*. The small number of vehicles fitted with these *Türme* were accepted for service with the *Wehrmacht* as there was a manufacturing shortage of the new weapon which precluded its being fitted.

Though extremely difficult to see in period photographs, the armour manufacturers started to install track pin return plates on the lower *Wanne*, these were designed to push loose track pins back into place as the tracks moved over the plate. These start to appear on completed vehicles around the end of January 1944. A modified exhaust stack on the port side was introduced in January 1944. There were fuel lines located on the port side of the engine which were prone to overheating causing the petrol/gasoline to vaporise before reaching the carburettors. This new design had two *Auspuffkühlung* pipes on either side of the main exhaust stack which drew cool air in around the manifold and poorly ventilated engine compartment. This was not a simple case of bolting the new exhaust on to the flange of the existing elbow from the manifold on the port side of the engine. The entire exhaust system on the port side of the engine had been modified to provide cooling and reduce the incidence of engine fires that occurred with the single exhaust stack design on the port side. It took a little time to include the new exhaust on all of the Panthers assembled so that there were a significant numbers of vehicles assembled by M·A·N, Daimler-Benz and M.N.H. with the new *Kugelblende* ball mount for the MG.34 and the original single exhaust stack on the port side[8]. Panther *Fgst.Nr.* 210718 completed by M·A·N on or about 6th February 1944 has a *Kugelblende* ball mount and the earlier exhaust system[9].

On 15th March *OKH WuG 6* informed the assembly plants that they would need to install a fuel vent line on the filler tank as a cross line on the rear starboard side of the *Wanne* according to drawing 021 48 328 Pages 1-2 according to Index 'M' of 23rd February on all new Panthers immediately to avoid a potential fire hazard. M.N.H. reported that they planned to start the conversion from vehicle 717 onwards, that is the 1st vehicle from order 60 091 (*Fgst.Nr.* 154497). In order to achieve this goal they had started production of the parts listed under Group U47 and U48 as well as all the other items necessary. The fuel vent line itself has to be installed in the final steps of the production process.

On 16th March, the head of the *Heeres-Abnahmestelle* informed the assembly plants that the troops would not accept those vehicles that were delivered to the *Heereszeugämter* without gun mantle seals. It was therefore necessary to make a subsequent delivery of seals 021 B 50261 U5 and 021 D 50261-1 to the *Heereszeugämter* as soon as possible. M.N.H. reported that they had not equipped vehicles 221 (*Fgst.Nr.* 154801) up to and including vehicle 627 (*Fgst.Nr.* 154407) with aforementioned seals. The manufacturer of these seals, Wetzel was unable to deliver the required quantity of synthetic Buna rubber (polymerized butadiene) seals 50261 U5, it was necessary to make use of a canvas version that was used as an intermediate solution. Abt.4111 instructed Mr. Bütefish, one of the management team at Daimler-Benz in Berlin, to identify the name of the company that makes these canvas seals. M.N.H. reported that they had asked Mr. Hofmeister the senior manager at Daimler-Benz to forward a sample of this seal on loan.

On 17th March the assembly plants were informed by the *Heeres-Waffenamt* that there would be a delay in supplying reinforced 50.1mm diameter torsion bars. Following consultations with M·A·N who had design responsibility of the Panther, permission was given to use a combination of reinforced and unreinforced bump stops during production until the reinforced 50.1mm diameter torsion bars were available. The assembly plants were to install these uniformly and to note down which vehicles received the torsion bars with the unreinforced bump stops which would enable the evaluation of this system if future problems occurred. M.N.H. was ordered to report the *Fahrgestell* numbers of these vehicles to Abt.716, so that they could be transferred to the Research Department at M·A·N. The assembly plants were instructed to make it a top priority, to combine the smaller diameter torsion bars with the unreinforced bump stops, when sufficient smaller diameter torsion bars (even if only for 1 vehicle) were available.

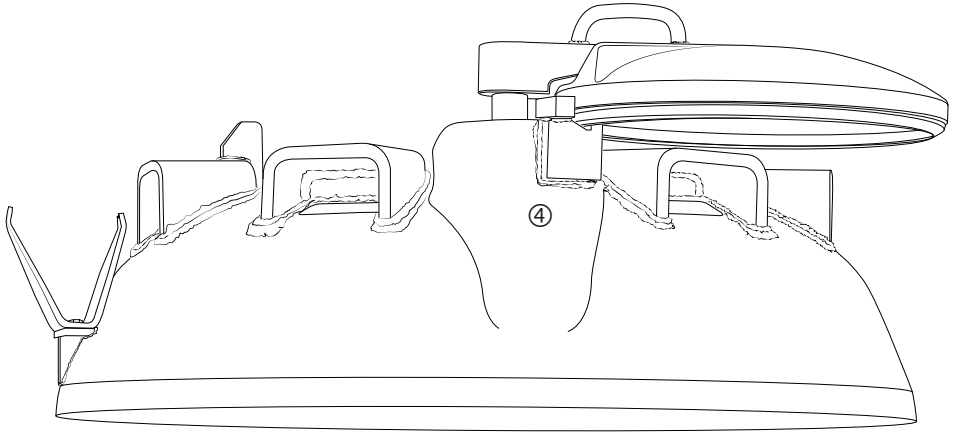
On 24th March the *Heeres-Waffenamt* provided clarification to M.N.H. regarding the seal in the gun breech 021 E 48301 U47. M·A·N had provided further information regarding the ring 48301-237 in response to a request made on 22nd March and indicated that the ring 48301-237 could be omitted. Plugs that are delivered by the armour manufacturer without ring 48301-237 can be utilized in this state.

The *Heeres-Waffenamt* sent confirmation to M.N.H. on 25th March that the installation of the auxiliary visor in the commander's cupola could not be omitted even when the *12-Uhr Zeigerring* (azimuth indicator ring) was installed. As a consequence, both components were to be installed together. M.N.H. had sent instructions to the sub contractor Huppman in Kitzingen that in future they were only to deliver commander's

8 There were numerous smaller detail modifications throughout the production life of the *Ausführung* A; these are all accurately listed in Jentz and Doyle's *Panzer Tracts No.5-2 Panzerkampfwagen Ausf. A* and *Germany's Panther Tank. The Quest for Combat Supremacy*.

9 Panther *Fgst.Nr.* 210178 as featured in *Germany's Panther Tank, The Quest for Combat Supremacy*, pp.72-73 was issued on 1st April 1944 to I./Pz.Rgt. 11 then operating with *Panzerverband Friebe.*

A new Panther *Ausführung* A at the M·A·N plant in early January 1944. One of the first design changes made after the introduction of the *Ausführung* A was the *Kugelblende* armoured ball mount which replaced the armoured flap for the M.G.34 in the glacis plate. The design change was present on Panthers that were completed by M·A·N in late November/early December 1943. The *Fliegerbeschussgerät* (anti aircraft mount) for the M.G.34 has been installed on the commander's cupola for the photograph. The Panthers assembled by M·A·N had the *Zimmerit* paste applied to the glacis plate in three distinct sections. The *Wannen* progressed down the assembly lines at Nürnberg nose to tail and employees used special sets of boarding ladders hung over the glacis plate that can be seen on page 21 to access the interior and upper surfaces. It was typically not removed when the *Wannen* were coated in *Zimmerit*, the area beneath the ladder would be coated later resulting in the mismatched ridged texture on the patched section in the centre of the glacis plate. (Johann Buchner M·A·N)



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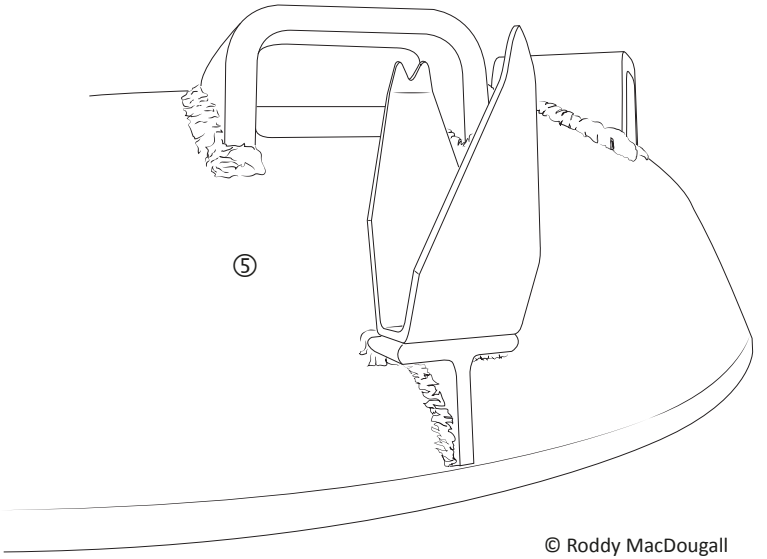

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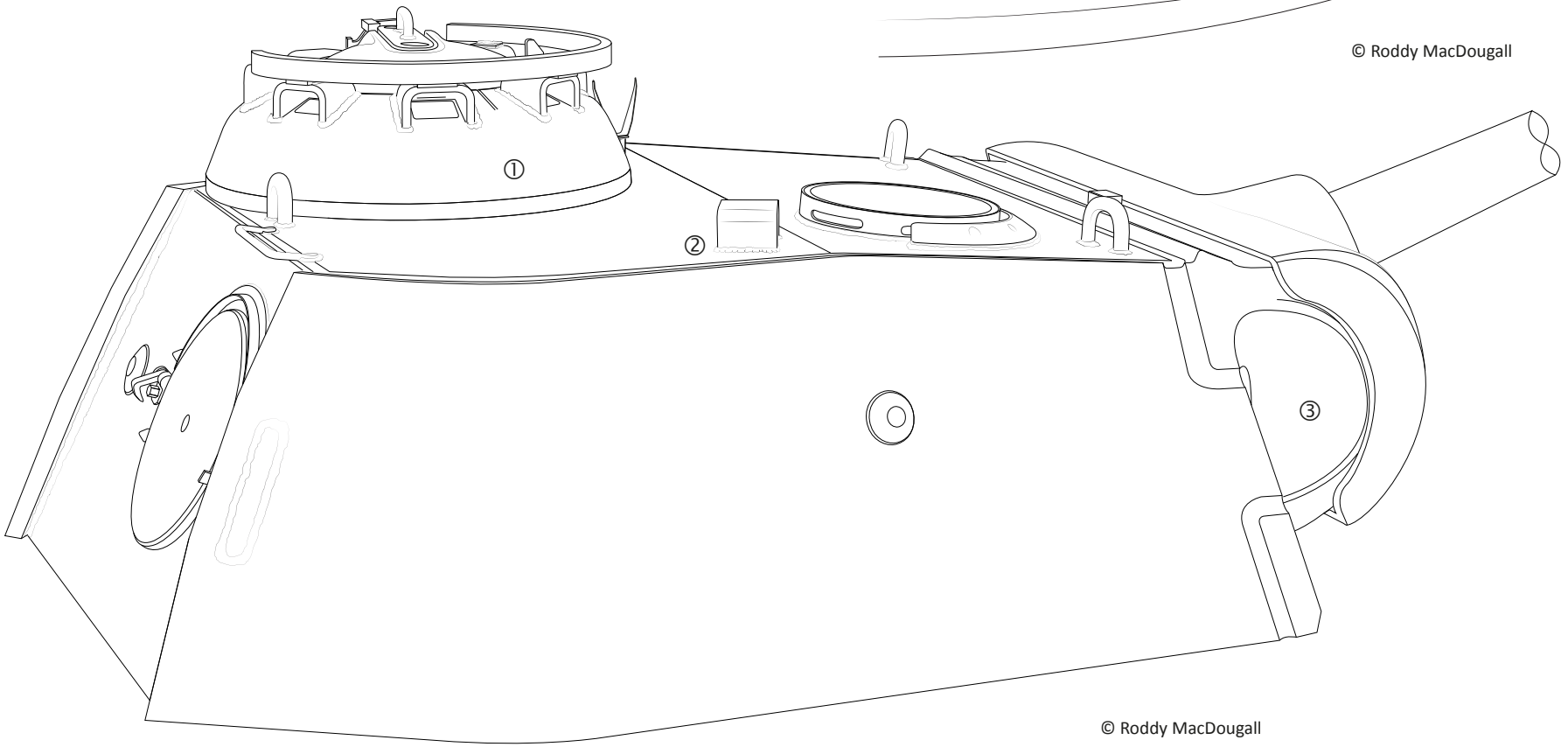

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Early *Ausführung* A Turm (Turret)

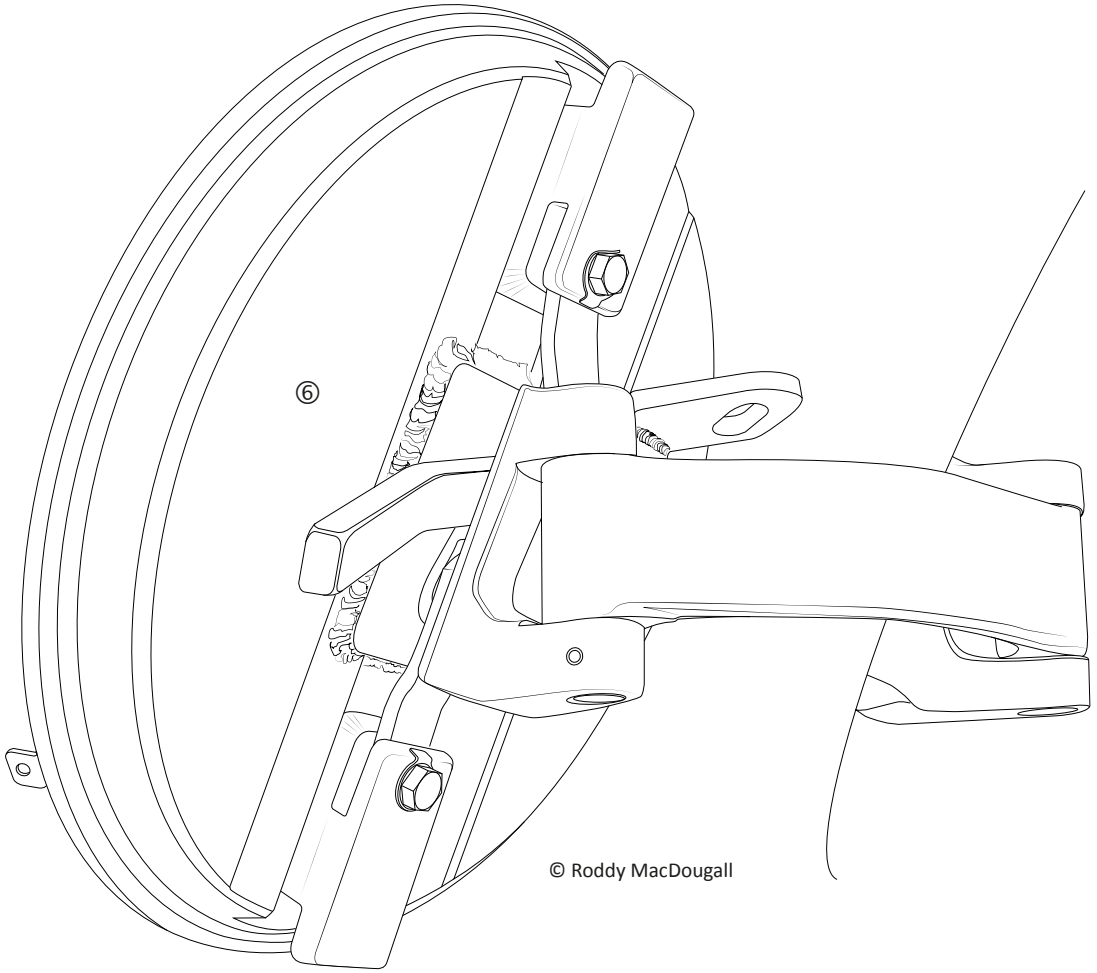
① The majority of *Ausführung* A Panthers were fitted with a new design of cast armoured commander's cupola with seven periscopes. The new design had improved ballistic protection and was ergonomically more efficient. The design had a considerably thicker hatch that was substantially more robust. It had previously been installed on at least one Pz.Bef.Wg. Panther *Ausführung* D prior to becoming the standard cupola for the majority of *Ausführung* A Panthers. M·A·N would continue to fit the older design of cupola to a small number of *Ausführung* A Panthers completed in September until stocks of this component were exhausted. ② The new *Turm* design now incorporated a periscope for the loader fitted to the *Turm* roof, prior to this he was effectively blind to the tactical situation outside the vehicle and could not assist with target acquisition or the defence of the vehicle without removing the pistol port plug. ③ The new casting for the front plate/trunnion armour now had dish shaped convex bulges on the sides over the gun trunnion, this design change was necessary to accommodate new waterproof seals. This new cast armour design along with the loader's periscope can be used to differentiate between *Ausführung* D and A *Türme*.

Daimler-Benz Bump Stop

④ The new cast commander's cupola on the initial *Ausführung* A Panthers completed by Daimler-Benz were fitted with a bump stop that had a considerably shorter steel base plate than those installed by the other assembly firms. The bump stop was intended to limit how far the commander's hatch would open as well as provide support to the 70kg hatch.

Sighting Vane

⑤ A detail view of the sighting vane and its mounting bracket on the new cast commander's cupola. This design detail would not change from its introduction to the end of production in 1945.

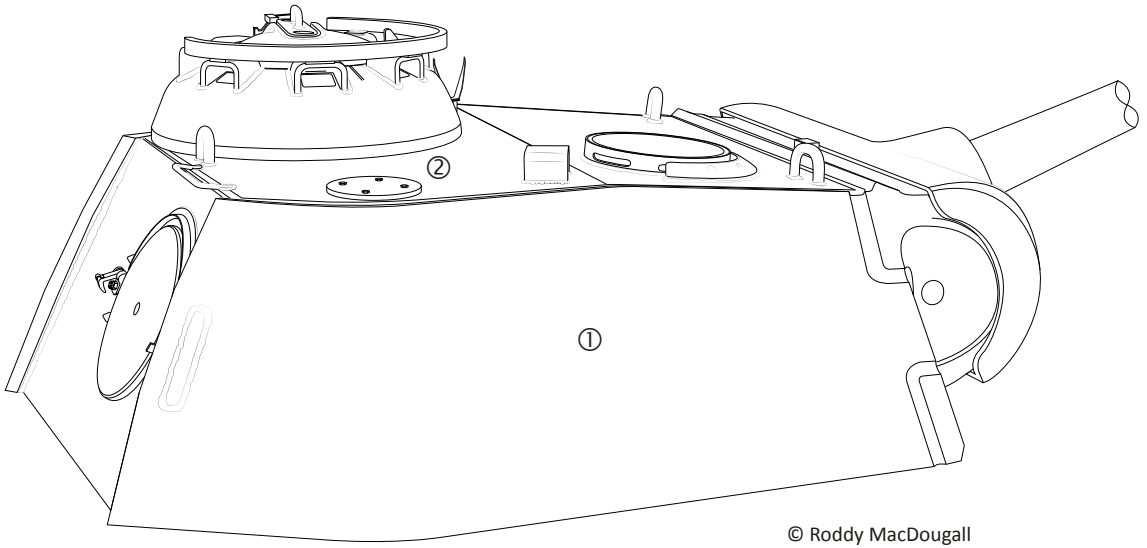


Loader's Hatch

⑥ The detail on the inner face of the loader's hatch in the *Turm*. Pushing the handle down operated a cam that forced the two locking bolts out to engage with the inner face of the *Turm* rear plate. A rubber seal was fitted to the rebate which formed a waterproof seal when the hatch was closed. The inner face of all the crews hatches that were visible when these were open were painted in *Dunkelgelb* RAL 7028 to match the exterior finish on the vehicles when they left the assembly plants.

Mid *Ausführung* A *Turm* (Turret)

① The pistol ports in the sides and rear plate of the *Türme* were deleted as they were due to be replaced with a roof mounted *Nahverteidigungswaffe* (close defence weapon). There were a small number of Türme delivered from the armour manufacturers that were devoid of either pistol ports or an aperture in the roof for the ② *Nahverteidigungswaffe*, these were subsequently fitted to Panthers that were completed in November and December 1943. It was intended that the new weapon would be introduced in December 1943 however, due to shortages the aperture was often covered with a circular bolted plate until sufficient quantities of this weapon to equip all of the vehicles being assembled became available.



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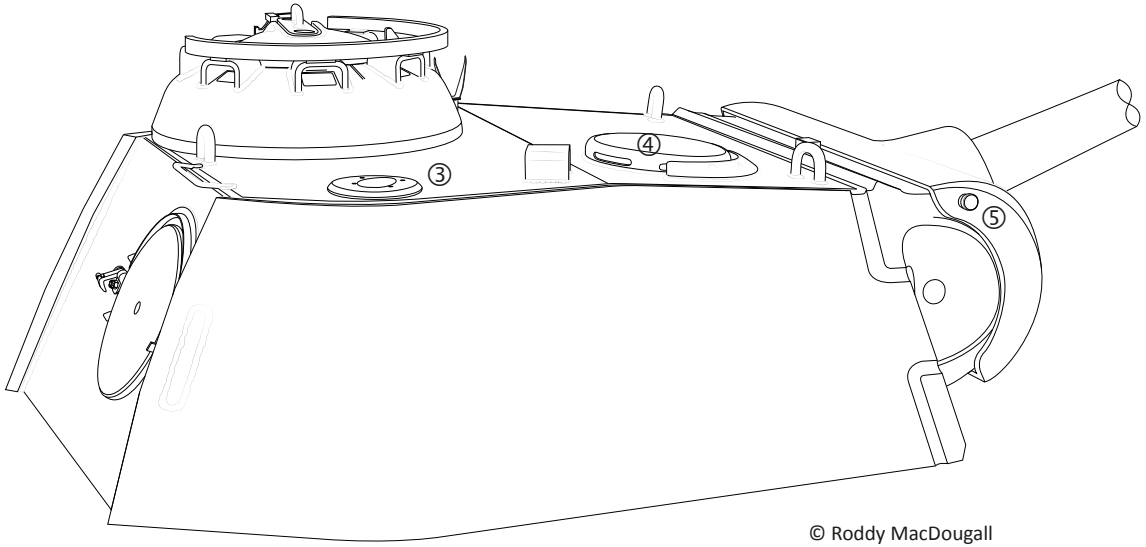

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Late *Ausführung* A *Turm* (Turret)

③ It would be April 1944 before there were sufficient supplies of the new *Nahverteidigungswaffe* to equip all new Panthers with this weapon. ④ A new forged armour ventilator cover would start to appear on the *Türme* of completed Panthers in July, it would never completely replace the original welded design of armoured cover which could still be found on Türme manufactured by Eisenwerke Oberdonau (KMY) fitted to new Panthers completed in the last weeks of the war. In April a small number of gun mantles that had ⑤lifting points cast into them started to appear sporadically on completed *Ausführung* A and G Panther completed by all of the assembly plants. These would be a standard feature on all Panther by the end of June 1944. These would become a standard feature seen on all new Panther towards the end of June 1944.

This photograph shows a Panther *Ausführung* A at the M·A·N assembly plant at Nürnberg in early January 1944. It allows us to see that there is no aperture for a *Nahverteidigungswaffe* (close defence weapon) on the *Turm* (turret) roof. This weapon would replace the pistol ports on the *Turm* sides and rear plate; however this *Turm* was delivered from the armour manufacturer without apertures for either set of components. The vehicle has been fully completed and has been finished in an overall coat of *Dunkelgelb* RAL 7028, the Rheinmetall designed 7.5cm Kw.K.42 L/70 has been left in the grey heat resistant lacquer that it was delivered in by the sub contractor who manufactured it. The black "*Ve. Kl. S*" or *Verlade Klasse Schwere* (heavy load class) shipping stencil for the Panther can be made out at the aft end of the gun cleaning tools tube. Note the *Wasser* (water) and *Benzin* (Gasoline) stencilling present on the filler cap armoured covers at the rear of the engine deck. (Johann Buchner M·A·N)

cupolas with the auxiliary visor installed. Any cupolas that were delivered from this source that lacked this visor would need to be reworked by M.N.H. in house.

One of the last of the modifications phased in between February and April 1944 was a new tow coupling welded to the central engine access plate which bolted to the rear *Wanne* underneath the exhausts. Around the end of January the jack stowage was changed to a vertical position between the exhaust stacks, this change was necessitated by the new welded tow coupling but predates its introduction. This new stowage arrangement was completed on Panthers assembled by M·A·N who were responsible for the revised design in February and included Panther *Fgst.Nr.* 210718 which still has the early exhaust system arrangement and Panther *Fgst.Nr.* 210747[10] completed by M·A·N on or about 13th February 1944 with the *Auspuffkühlung* exhaust system.

The *Heeres-Waffenamt* wrote the following memo to M.N.H. on 28th March regarding the changes to the vehicle jack specified for the Panther.
"Referring to our memo from 14.3 we would like to announce that M·A·N has temporarily unified the jack stowage bracket 48382 U48 for the IW20 and RWS 20 jacks. Subsequently we can bring the 20t jack and motor cover with integrated tow bar in to service earlier than envisaged.

M.N.H. planned to install the RWS 20 jack (30 pieces in stock) and subsequently the IW 20 jack (70 pieces in stock) along with the motor cover and integrated tow bar from vehicle 761, *Fgst.Nr.* 155341 on. Special production drawings would be supplied to cover this installation. The jack stowage bracket 48382 U48 will be welded to the back plate of the *Wanne* with two side weld seams during initial assembly. The vehicles were to be equipped with vertically arranged jack holders and the motor cover with integrated tow bar at the final assembly line until stocks of the older jacks were exhausted. The remaining stock of 15t Schober-jacks were not to be abandoned as *OKH Wa.Prüf 6* had asked M·A·N whether it was possible to install an expedient jack stowage bracket for these that held the jack perpendicular to the rear of the *Wanne*. Stocks of the old motor cover 48301 U53 that would be used until the introduction of the vertical jack stowage, these were to be manufactured for M.N.H. by Ruhrstahl Hattingen. M.N.H. completed their first Panther *Fgst.Nr.* 155341 with the revised design on 16th April 1944[11].

The *Heeres-Waffenamt* wrote to the assembly plants regarding the water discharge connection to the engine 021 B 48329. M·A·N had been informed by Maybach, that vehicles were delivered to the troops with the cooling water discharge incorrectly installed. Instead of using the flexible hose 48329-97 as shown on the drawing, a rigid hose had been used. The assembly plants were reminded that a rigid hose was never to be installed for this connection.

10 Panther *Fgst.Nr.* 210747 was issued to 3./SS-Pz.Rgt. 1, however this vehicle was completed without the new welded tow coupling.

11 Jentz and Doyle: *Panzer Tracts No.5-2 Panzerkampfwagen Panther Ausf. A.*

The M.N.H. assembly plant was notified on 11th April that a revised design for the driver and radio operator's entrance with double handles 021 B 50536 was to be implemented on the *Ausführung* A. These boarding handles were welded internally on the *Wanne* roof after the delivery of the parts for these hatches. The handles were to be fitted from vehicle 780 onwards, that is the 64th vehicle from order 60 091, *Fgst. Nr.* 155360.

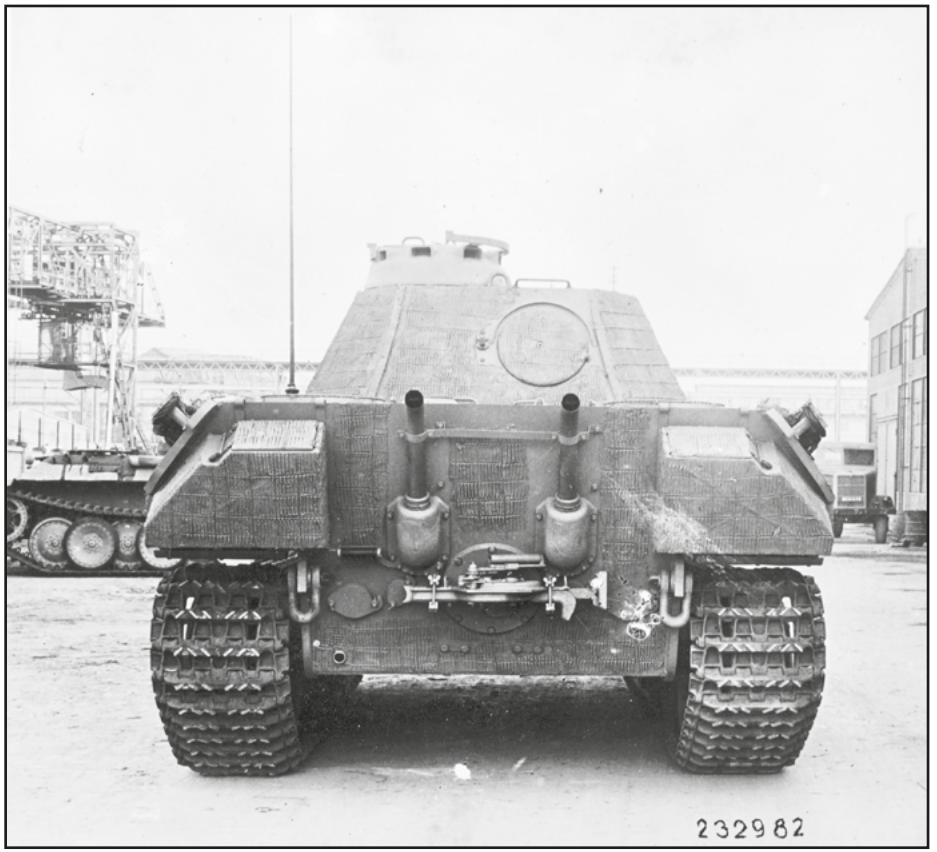
A further communication was received by M.N.H. from the *Heeres-Waffenamt* on 11th April following clarification from *Wa.Prüf 6*. It was necessary for M.N.H. to continue the installation of the *12-Uhr-Zeigerring* (azimuth indicator ring) in the commander's cupola without the power unit. This enabled the installation of an unspecified special device. M.N.H. was instructed to ensure that the cut-outs in the ring must be made in accordance with drawing SD 10112. This was to be implemented from vehicle 717 onwards, that is the 1st vehicle from order 60 091 or *Fgst.Nr.* 155297. The unused power units were to be returned to the *Heeres-Waffenamt*.

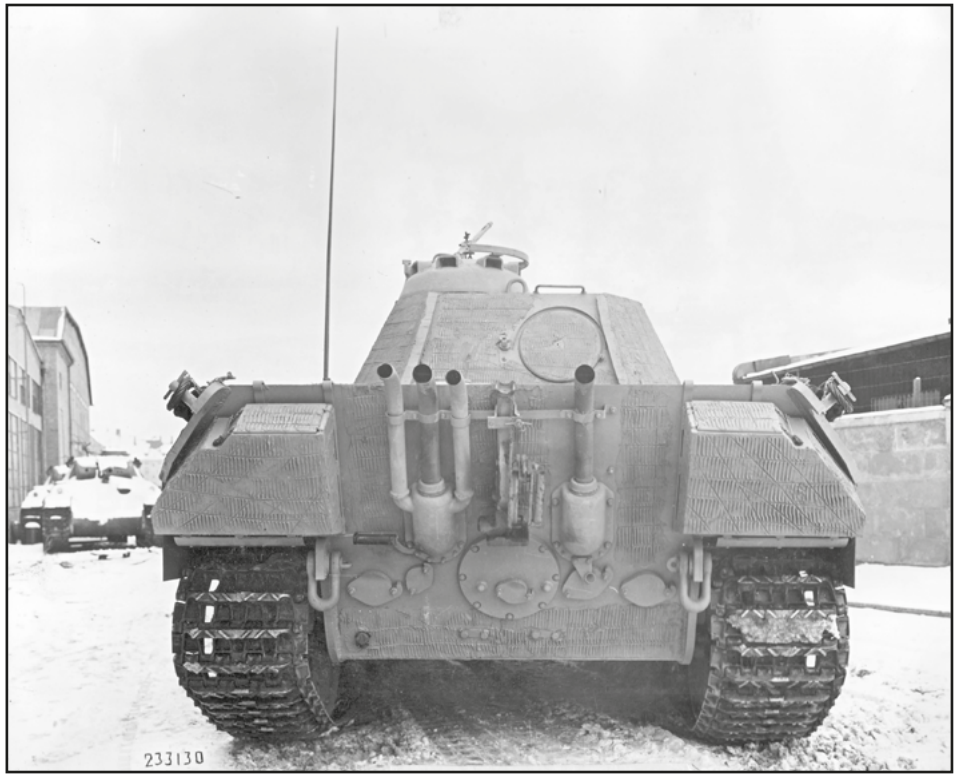
On 24th April M.N.H. corresponded with the *Heeres-Waffenamt* on the situation caused by a shortage of components for the *Lenk und Bremsbetätigung* 48378 (steering and brake controls). As a result of a shortage of key components for the Teves-system, it was not possible to equip all new vehicles that were currently being assembled with complete steering and brake controls. Taking into account the 40 vehicles at the assembly plant that needed to be moved around, M.N.H. had been ordered to remove the pending steering components from these 40 vehicles after they were completed and loaded on railway wagons for transport to the *Heereszeugämter.* The steering components were then stripped out and used for the vehicles still on the assembly lines. After careful examination the following *instruction was sent to M.N.H.*:

Sixty April production vehicles, including vehicle 776 (*Fgst.Nr.* 155356), would be delivered with complete steering and brake controls. The following key components were missing from vehicle 777 up to and including vehicle 800 (*Fgst.Nr.* 155357 to *Fgst.Nr.* 155380).

1. Betätigungszylinder (left and right): 48371-100 und 48371-101
2. Zwischenstück: 48371-104
3. Verschlußschraube: 48371-112
4. Hohlschraube: 48371-111
5. Behälter-Verschraubung: 48371-1
6. Ringstutzen: 48371-138
7. Ringstutzen: 48371-206

Right:
There had been a number of motor compartment fires on *Ausführung* D Panthers following its introduction to service. The *Kampf Versandberiet* programme solved a lot of the initial teething problems however, there was still a problem with cooling the port side of the motor compartment. The fuel lines, pump and carburettors were adjacent to the exhaust manifold which could generate enough heat to start vaporising the gasoline in the fuel lines which was then prone to ignite. The problem had been identified and M·A·N and Maybach were still in the process of redesigning the manifold and exhaust system to rectify this when the *Ausführung* D was superseded by the Ausführung A. The new series would continue to use the twin exhaust stack arrangement until the end of January 1944. A new centrally mounted tow coupling was to have been introduced that bolted to the lower edge of the rear plate and belly. This proved to be unsuitable as it reduced the Panthers angle of approach and departure from gradients, however the *Heeres-Waffenamt* had already issued instructions to the armour manufacturers to drill pilot holes for this coupling in the *Wanne*. The assembly firms plugged these with two steel plates secured with two bolts each that can be seen underneath the circular motor cover access hatch on both of these Panthers. (Johann Buchner M·A·N)





Left:
The new exhaust system with its distinctive *Auspuffkühlung* pipes on either side of the main port side exhaust stack; these drew cool air in around the manifold in the poorly ventilated engine compartment and rectified the cooling problem. This Panther has the modified stowage bracket that held the vehicle's jack vertically. This design change was brought about by the imminent introduction of the central engine access hatch with integral tow coupling on the rear plate, this new tow coupling design would have been fouled by the original horizontal jack stowage. The redesigned bracket was also capable of accommodating the RWS 20 and IW 20 jacks to replace the 15ton Schober jack originally specified. Both M.N.H. and Demag would alter the existing brackets as an interim solution to allow the jack to be stowed vertically until the drawings for the redesigned brackets were completed by M·A·N. (Johann Buchner M·A·N)

8. Rohrverbindungsstutzen: 48371-146
9. Rohrverbindung mit Schwingungsdämpfer: 48371-113

Component 1 was not to be obtained. Components 2 to 5, 8 and 9 were to be immediately replaced by components that M.N.H. would manufacture in-house and would be used up to and including the production scheduled for May. Abt.4111 will engage itself in obtaining basic components for numbers 6 and 7 for immediate in-house production till and including the May production. With these measures it will be possible to deliver vehicles 777 to 800 with the Teves-system (excluding the part under number 1). Hydraulic lines 4 and 5 and 10 and 11 are to be bypassed using hoses 48371-102 and -103. From the vehicle 801 (*Fgst.Nr.* 155381) on, new instructions for the Teves-system were to be obtained at short notice. Abt.4111 was ordered to take all necessary steps to obtain stocks of clutch cylinders 48367-205 and control valves 48367-186. This was continued on 26th April:

"In our memo from 24th we announced that instructions would follow for the installation of the Teves-system from vehicle 801 on. The following is hereby established: we did not succeed in obtaining the control valves and clutch cylinders that are missing from vehicle 801 on. The hydraulic lines 6 and 7 or 7 and 8 are to be bypassed. Mister Ebeling and Mister Bünger ordered that this bypass was to be carried out on the control valve or clutch cylinder hose. To clarify the delivery status from vehicle 801 onwards we summarize once again: the vehicles have been fitted with a complete Teves-system but lack the operating cylinder, clutch cylinder and the control valve. Complying with our memo from 24th these three components need to be removed again. As soon as the missing parts are back available new directions will follow".

The components were eventually sourced and all of the vehicles affected were brought up to standard.

The introduction and trials for new components were not exclusively conducted on vehicles assembled by M·A·N other assembly plants trialled new components to test their suitability for series production. One of the components first trialled by M.N.H. which was subsequently introduced to production in limited numbers on the *Ausführung* G by M·A·N and at least one of the I.R. prepared Panthers completed by Daimler-Benz was an intermediate strengthened gun mantle. These are difficult to see on vehicles assembled prior to September 1944 because the *Zimmerit* texture helps disguise the shape. However photographic evidence indicates that these were

The driver and radio operator's hatches on the Panther *Ausführung* D and A used considerable resources and were labour intensive to manufacture. The forgings used required expensive machining and there were a considerable number of components for each hatch. They were held open by a substantial spring loaded latch that was welded to the driver and radio operator's roof plate. They did however, have the advantage of not being blocked by the *Turm* when this was traversed. The design of these hatches would be changed for a much simpler arrangement for the forthcoming Panther *Ausführung* G series that did not require the extensively machined components used for the earlier design. The gun cleaning tools tube of this Panther *Ausführung* A from II./SS-Pz.Rgt. 5 has spring loaded end caps and the Turm has a T.Z.F. 12 binocular gunsight fitted indicating it was completed between October and early December 1943. (NARA KB Mielke via Darren Neely)

first fitted to M.N.H. *Ausführung* A Panthers assembled in June 1944. This design had thicker armour extending horizontally in a rectangle on either side of the gun tube aperture. The size of this rectangle varied slightly, this was possibly as a result of having more than one sub contractor involved in their manufacture[12]. They were fitted to Panthers assembled by M.N.H. and as well as Pz.Bef.Wg. Panthers and a very small number of Panthers assembled by M·A·N until the introduction of the new strengthened "Chin" mantle from drawing 01 St 50258.

There are no surviving documents regarding this intermediate design of strengthened mantle. It appears in numerous period photographs and an examination of the surviving example indicates that it is not a casting flaw or the failure by the component manufacturer to remove excess metal left by the design of the mould and casting process.[13] There is documentation showing that *Heeres-Waffenamt* inspectors did issue instructions for excess material to be removed from gun mantle's by the armour sub component manufacturers, this excess material is typically two round "plateaus" of armour standing proud from the curved face of the mantle, the edges of which created a shot trap that would prevent rounds from ricocheting off the curved face that the design drawing 021 St 50255 indicated should be present[14]. The circles with horizontal milling marks left when excess material was removed on the mantle face are quite noticeable on vehicles that do not have *Zimmerit*. This was not limited to mantles fitted to the *Ausführung* A; these reworked castings can also be seen on the *Ausführung* D and G. In April a small number of gun mantles that had lifting points cast into them started to appear sporadically on completed Panther *Ausführung* A and G from all of the assembly plants, these would become a standard feature seen on all new Panther towards the end of June. These lifting points can be seen on Panther *Fgst.Nr.* 120305[15] completed by M·A·N on or about the 2nd April 1944. A new design of forged armoured cover for the *Turm* roof ventilator was introduced; this gradually started to be seen on increasing numbers of Panthers but would never completely replace the welded design of armoured cover which could still be found on Panthers completed in the last weeks of the war[16].

12 A Panther with this type of mantle *Fgst.Nr.* 155597 was captured from *Kampfgruppe* Hennecke from I./Pz.Rgt. 6 during the fighting for Paris. This Panther was completed by M.N.H. on or around 25th June 1944.

13 Any sub-standard component would in any case have been rejected by the *Heeres-Waffenamt* inspectors at the armour manufacturer's premises.

14 The drawing number references for the *Turm* components for the *Ausf.* A can be found in *Panzer Tracts No.5-2 Panzerkampfwagen Panther Ausf. A.*

15 Panther *Fgst.Nr.* 120305 featured in *Nürnberg's Panzer Factory*.

16 Panthers with the earlier design of armoured cover were amongst those issued to I./Pz.Rgt. 3 and knocked out in Steinach an der Saale in April 1945.

Panther *Ausführung* A Fgst.Nr. 155597 photographed after its capture by Free French forces from *Kampfgruppe* Hennecke whose armoured component consisted of elements of I./Pz.Rgt. 6 during the fighting for Paris. It was completed by M.N.H. on or around 25th June 1944 and was finished in an overall coat of Dunkelgelb RAL 7028 that was devoid of any unit insignia or tactical markings when it was captured. A shell has torn a chunk of armour out of the glacis plate above the port sponson during an engagement with an M4 Sherman Tank at the Jardin du Luxembourg in the centre of Paris. The damage caused can clearly be seen in this photograph and is still visible on this Panther today. It has a factory applied coating of *Zimmerit* paste with a smooth surface texture that is only found on a number of Panthers completed by M.N.H from early 1944 on. This is one of the earliest Panthers identified to date that has been fitted with the intermediate pattern of strengthened gun mantle. Following its capture it was pressed into service by Free French forces and continued to be used by the French army after the war. This vehicle is currently on display at the Mourmelon-le-Grand military base, it has recently been "restored" with parts and features that are quite dissimilar to those found on the Panther when it was captured. (Roddy MacDougall)

Although badly damaged the relatively smooth surface texture of the *Zimmerit* coating on this M.N.H. assembled Panther *Ausführung* A can clearly be seen in this photograph. The thin foundation coat can be seen just above the shell damage in the centre of the glacis plate, there is no anti spall grid scored into this coat which would have been almost fully cured prior to the application of the thicker second coating of Zimmerit. This vehicle was issued to I./SS-Pz.Rgt. 1 and was knocked out in the vicinity of Mortain during the Normandy campaign. (NARA via Darren Neely)

A Panther *Ausführung* A assembled by M.N.H. in June 1944 from *Kampfgruppe* Hennecke knocked out during the fighting in the centre of Paris in September 1944. The Zimmerit paste has a rough surface texture and the spacing of the anti spall grid scored into the *Zimmerit* is at the smaller end of the scale. This illustrates the difficulty of identifying whether Daimler-Benz or M.N.H. completed a particular vehicle based on the appearance of the Zimmerit paste alone. Some of the locals are examining a damaged section of armour that has been lost from the port side of the *Fahrgestell*. (Lee Archer)

6. INTRODUCTION OF THE PANTHER AUSFÜHRUNG G

The decisions that led to the Panther *Ausführung* G were made at a meeting at M·A·N on 4th May 1943[1]. The Panther *Ausführung* G was created by mounting the existing *Turm* design from the Panther *Ausführung* A to a new *Wanne* design[2]. The introduction of the new vehicle would be staggered at three of the assembly plants that had previously assembled the Panther *Ausführung* A. The first assembly plant to commence production would be M·A·N in Nürnberg starting with *Fgst.Nr.* 120301 in March 1944. Daimler-Benz in Berlin Marienfelde then followed two months later in May 1944 with *Fgst.Nr.* 124301 and finally M.N.H. in Hannover switched over with *Fgst.Nr.* 128301 in July 1944[3]. The war situation had swung from Germany's favour with the Red Army gaining ground in the east and the *Wehrmacht* having to hold forces they could not spare in the West to counter the expected landings by the Western Allies on the beaches of France. Germany was being bombed by the U.S.A.A.F by day and the R.A.F. by night; the effects of this were inevitably having an impact on the assembly plants involved in Panther production. When modifications to the design or new components were introduced these were not always seamlessly introduced by all of the assembly plants in the same way that they had been able to do so when modifications were introduced during production of the *Ausführung* D and A. This has led to some interesting anomalies that can be used to advantage when trying to determine the age and the production plant for particular vehicles. We will look the each of the assembly plants in the chronological order that they switched over production to the Panther *Ausführung* G and examine the modifications introduced by each of the assembly plants that affected the appearance of these machines during their production life.

M·A·N switched over to *Ausführung* G production in March 1944 and was able to report to the *Panzerkommission* on 3rd April 1944 that no significant problems were foreseen in the production series[4]. As previously mentioned the *Ausführung* G was a combination of the existing *Turm* from the *Ausführung* A series mounted a new simplified *Wanne* design that utilised exactly the same running gear as the *Ausführung* A. As far as the vehicle crews were concerned the significant differences were that the driver now had a rotating periscope rather than a direct vision slit in the glacis and that both the driver and radio operator's hatches had been changed from lift and swivel hatches to a design that opened up in a horizontal arc. These hatches were cheaper and easier to manufacture than the design used on the *Ausführung* D and A however, they could foul against the *Turm* at certain angles of *Turm* traverse which was something of a drawback. In April 1944 M·A·N started fitting Jettisonable hatches for the driver and radio operator; these can be seen on the Panther *Ausf.* G's issued to both I./SS-Pz.Rgt. 12 and I./SS-Pz.Rgt. 1 in May 1944. Panther *Fgst.Nr.* 120360 and *Fgst.Nr.* 120404 completed by M·A·N. in April 1944 were both fitted with Jettisonable hatches[5]. Another Panther *Ausf.* G assembled by M·A·N with this design modification was issued to I./SS-Pz.Rgt. 12 between 16th and 24th May was knocked out in Bretteville- L'Orgueilleuse in Normandy on the night of 8th/9th June 1944. Panther *Fgst.Nr.* 124317 was the 17th *Ausführung* G assembled By Daimler-Benz and was completed in May while Panther *Fgst.Nr.* 128303 was the 3rd *Ausführung* G assembled by M.N.H. who completed this vehicle in July 1944; both of these Panthers have Jettisonable hatches fitted[6]. It is probable that this feature was present on all *Ausführung* G Panthers, however the official notification for this design modification was not sent to M.N.H. until August 1944.

The initial design for the *Ausführung* G did not have timber bump stops/dampers or

1 Jentz and Doyle: *Panzer Tracts No.5-3 Panzerkampfwagen Panther Ausf. G.*

2 Jentz and Doyle: *Germany's Panther Tank, The Quest for Combat Supremacy.*

3 Jentz and Doyle: *Ibid.*

4 Jentz and Doyle: *Panzer Tracts No.5-3 Panzerkampfwagen Panther Ausf. G.*

5 Panther *Fgst.Nr.* 120360 was originally issued to 1./SS-Pz.Rgt. 12 and had the tactical number 126. This Panther was later transferred to 3./SS-Pz.Rgt. 12 and renumbered 308. Panther *Fgst.Nr.* 120404 was also issued to 1./SS-Pz.Rgt. 12 and had the tactical number 135. Both vehicles were captured by Allied forces in Normandy and were extensively evaluated at Bovington before being expended during firing trials to test the effectiveness of various ammunition types against the Panther's armour.

6 Both Daimler-Benz assembled vehicles were issued to I./Pz.Rgt. 24, the M.N.H. assembled Panther is currently on display at Kubinka and was porobably issued to I./Pz.Rgt. 31 or I./Pz.Rgt. 35.

Opposite page and overleaf:
An *"Abnahmefeier von neuen Panzern"* (acceptance ceremony for a new tank) was held inside the M·A·N plant in Nürnberg at the end of March 1944 for the first series production *Ausführung* G Panthers that would be issued to the troops. It was the custom at M·A·N as well as other assembly plants and vehicle manufacturers to decorate the first vehicle in a new series with garlands as part of the ceremony to mark the introduction of a new vehicle type. The *Hakenkreuzfahnne* which replaced the black white and red tricolour as the German national flag on 13th March 1933 has been placed on the leading Panther's glacis plate. This was an official ceremony that included senior managers M·A·N as well as the senior *Heeres-Waffenamt* inspector at the plant, Hauptmann Klauder, representing the *Wehrmacht* to accept these first vehicles into service with the *Wehrmacht.* It would be very unusual if the then German national flag had not been used during the ceremony. The Panthers have been finished in an overall coat of *Dunkelgelb* RAL 7028 apart from the 7.5cm Kw.K.42 L/70 gun barrels which are still in the grey heat resistant lacquer these were delivered in. All of the vertical armour plates and sheet metal components have

a coating of *Zimmerit* anti magnetic paste. This paste was applied in the same manner and textured using the same ridged roller tool used at the Nürnberg plant for the *Ausführung* A so that the surface texture is identical between the two *Ausführung*. Note that all of these Panthers have timber bump stops fitted for the driver and radio operators hatches. They have also been equipped with spare tracks, tow cables and towing clevis's prior to being shipped to the *Heeres-Zeugammter.* The levels of equipment present on completed vehicles leaving the assembly plants would change as the war progressed and the *Wehrmacht* was forced to adopt a more pragmatic approach to equipping vehicles so that they might be brought into service in as short a timescale as possible. (2 X Johann Buchner M·A·N)

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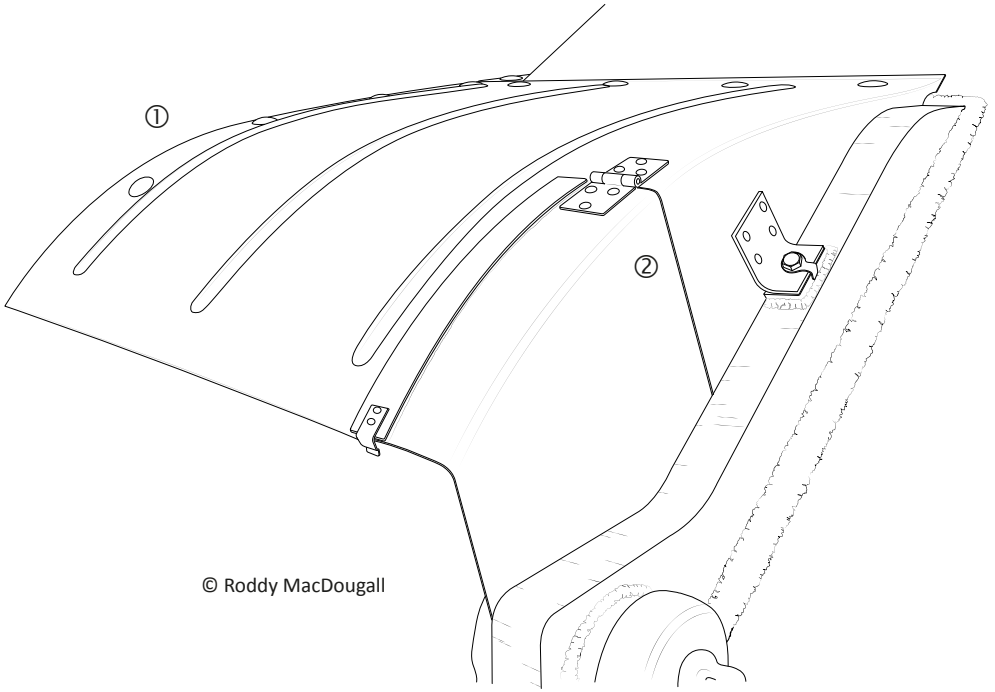
Ausführung G Fenders

① The *Ausführung* G series was fitted with a new fender design that dispensed with the extensions used on the *Ausführung* D and A which had to be removed for rail transport. It had three strengthening ribs instead of the four used on the previous design and there was no provision for width indicators to be fitted. ② A hinged section on the inboard side allowed access to the tow shackles fitted to the eyes incorporated into the Wanne side extensions. These were secured in place with a spring clip on the leading edge that fastened on to the corresponding leading edge of the fender adjacent to it.



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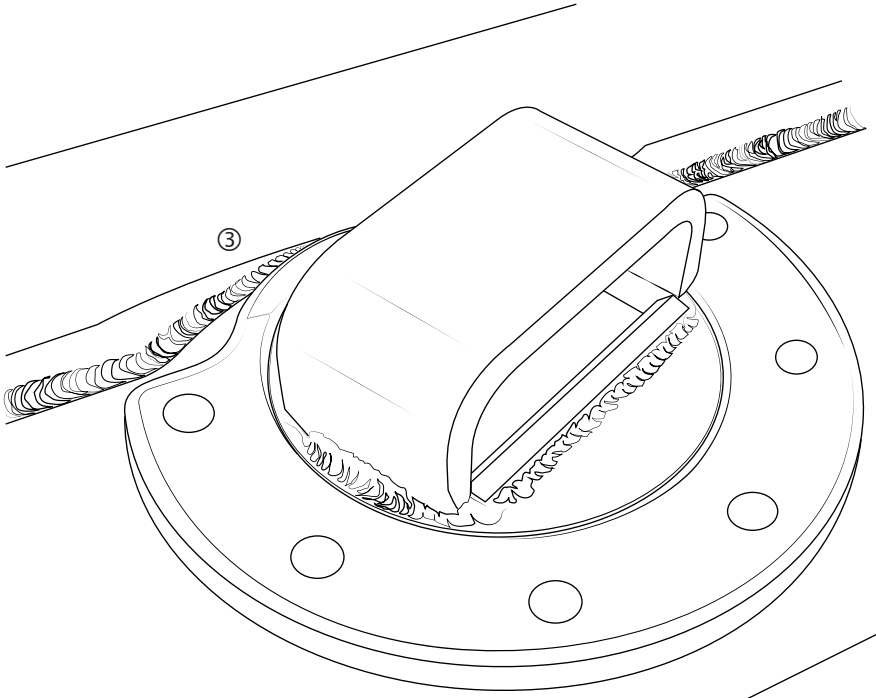

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Ausführung G Driver's Optics

The armoured visor and vision block that was mounted in the glacis plate on the *Ausführung* D and A series had not been revised since the start of production. There were some drawbacks to the original design including the expensive and time consuming precision machining required for the aperture in the glacis plate. The aperture also had a detrimental affect on the balistic integrity of the glacis. ③ A new drivers periscope design that was mounted on the new *Ausführung* G series *Fahrgestell* roof replaced the vision block. The new periscope arrangement could be revolved to allow better peripheral vision for the driver than that available using either the vision block in the glacis or the fixed roof mounted periscope on the *Ausführung* D and A series. The square cut opening in the upper edge of the glacis plate that had been used for the fixed roof mounted periscope on the original design was retained. However, this would be revised on the *Ausführung* G series in July 1944 when the first Wannen with a circular opening in the glacis were completed in July 1944.

handles on the driver or radio operator's hatches when assembly commenced at the Nürnberg plant, the design was quickly modified to include these before any series production Panther *Ausführung* G were completed for issue to the troops and an amendment to the design was sent to the other assembly firms instructing them to include these before commencing production of the new series. The drawings and specification for the *Ausführung* G had been distributed to both Daimler-Benz and M.N.H. prior to their scheduled changeover from *Ausf.* A to *Ausf.* G production. The sub contractors supplying components had also started to deliver some of the new components so that there would be adequate stocks of these once series production was under way. This resulted in several official notifications for the introduction of design modifications being issued through the *Heeres-Waffenamt* that had already been introduced on series production vehicles which we will try to highlight. The tubular levers designed to assist the crew with closing the hatches initially had a hinge that only allowed them to travel through 90° from their stowed position. It would be fair to say that this hinge and handle arrangement was a source of regular complaints from the troops that would result in several requests and attempts to redesign these hinges. None of these would be entirely successful and modifications were still being made to the design as late as the middle of February 1945. The hinge base had a lug that stopped the travel of the lever so that when the hatch was open it stood vertically, this was quickly found to be inconvenient as the crew member needed to expose his torso in order to grasp this handle and close the hatch[7]. This was modified according to the preliminary drawing PV-G 520 by grinding off the lug which allowed the lever to travel through 180° so that the crewman only needed to reach up from his seat to grasp the handle and close the hatch. This was quickly modified by grinding off the lug which allowed the lever to travel through 180° so that the crewman need only reach up from his seat to grasp the handle and close the hatch. A new simplified hinge and lever were quickly introduced, however stocks of the original design were modified and continued to be used until exhausted. The new design is characterised by having a lever fabricated from steel tube with a flat bar hinge section rather than the machined cylindrical hinge section of the earlier design. The new hinged lever used by the crew to assist in closing the hatch was designed so that the forks theoretically applied enough friction to prevent the handle from dropping down and injuring the crewman below it. As we shall see, this was not entirely successful. The sections of the spring assisted levers that were fixed to the *Wanne* roof that would be visible when the hatch was open were painted in *Dunkelgelb* RAL 7028 rather than *Elfenbein* used for the Panthers interior.

The motor compartment had been redesigned rectifying the cooling problem with the port exhaust manifold. As a result of this the *Auspuffkühlung* auxiliary cooling pipes that had been installed on the port side exhaust stack of the *Ausf.* A was dropped from the *Ausf.* G. The vehicle's jack was stowed vertically between the exhaust stacks and had sheet metal braces which connected the jack bracket on either side to the exhaust brackets. The armoured guards for the exhaust elbows were the cast design carried over from the *Ausf.* A. The order regarding the application of *Zimmerit* anti magnetic paste had not been rescinded so that all of the vertical armour faces and sheet metal components that had received a coat of *Zimmerit* anti magnetic paste on the *Ausf.* A were also given this coating on the *Ausführung* G. The *Zimmerit* was finished using the same tools and techniques that M·A·N had previously used on the *Ausführung* A Panthers they had assembled. A small triangular brace was welded to the rear *Turm* lifting point; a few of the initial *Ausführung* G were completed without this brace in April 1944. This brace was not fitted to *Türme* mounted on the *Ausf.* A[8]. New Panthers typically had the vehicle's *Fgst.Nr.* stencilled in black or white on the glacis plate or on the gun travel lock. When this is not visible on the *Ausführung* D and A it is usually as a result of the crew or unit *Werkstatt* having obscured this when applying the vehicle's camouflage or the quality of the photograph being examined. The only reasonably consistent exception to the presence of the "A" marking is a number of *Ausführung* G *Pz.Bef.Wg* Panthers. Following the introduction of the *Ausführung* G, M·A·N would continue this practice which has helped tremendously in identifying when specific features or design modifications were introduced or made. The external application of *Fgst.Nr.* on Panther *Ausf.* G by Daimler-Benz was rather more haphazard and to all intents and purposes ceased completely in July 1944. This has resulted in a relatively small percentage of *Ausführung* G assembled by Daimler-Benz where this number is visible allowing the vehicle's date of completion to be verified in period photographs. During the transition to assembly of the *Ausführung* G, M.N.H. also ceased stencilling the *Fahrgestell* number on the glacis or gun travel lock with a single known exception that was completed in 1945. The majority of the preserved vehicles were assembled by M.N.H. so that it is still possible to accurately date when modifications to the design were implemented by this assembly plant.

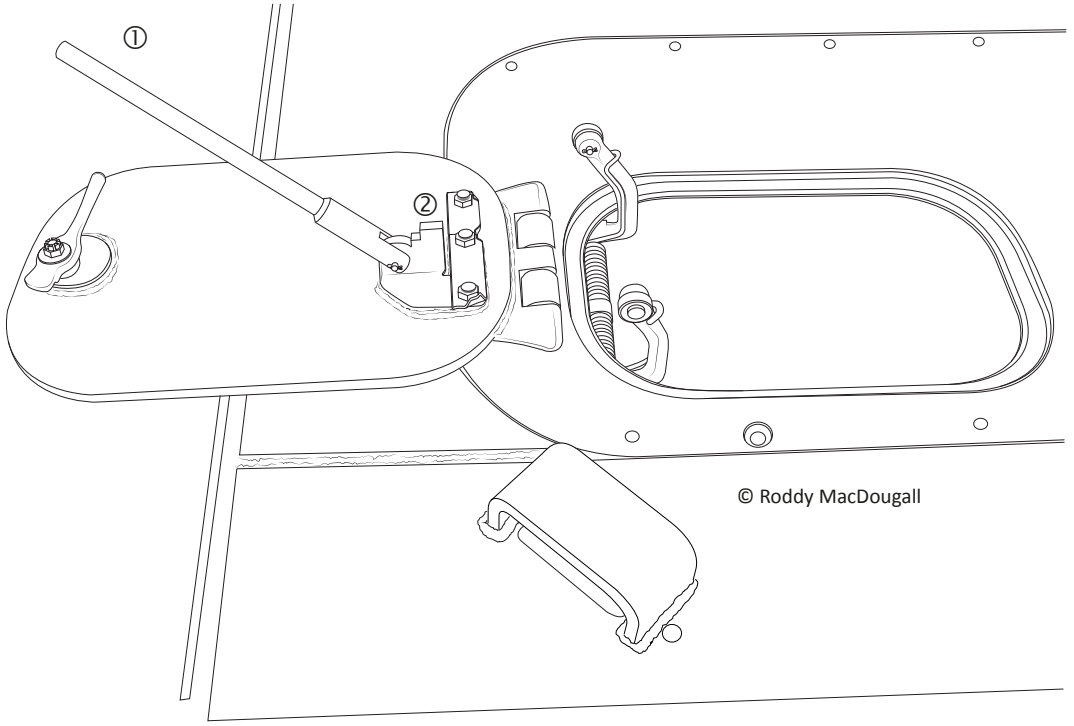
The placement of the *Balkenkreuz* on Panther *Ausführung* G completed and accepted for service by the *Wehrmacht* by the three assembly firms involved in the Panther programme would remain the same at each of the assembly plants from their introduction of the *Ausführung* G in March 1944 up to early 1945. This has allowed the accurate identification of the original assembly firm of any given Panther when other identifying features such as *Zimmerit* texture or *Fgst.Nr.* are not clearly visible or are absent. The *Balkenkreuze* applied to Panthers assembled by M·A·N were applied to the front corners of the *Fahrgestell* just ahead of the tool stowage brackets on both the port and starboard side. The initial vehicles had the *Balkenkreuze* applied to the rear plate behind the vehicle's jack, this was very short lived however and did not last any more than a few weeks as it is barely visible in this location. The location for the rear *Balkenkreuz* was quickly moved to the starboard side *Gepäckkasten* or stowage bin. A significant number of Pz.Bef.Wg. Panthers had an alternative placement where *Balkenkreuze* were only applied to the *Turm* sides with the rear plate bereft of this marking. This alternative arrangement does not appear to have been driven by the time frame of a vehicles assembly with both combinations appearing on Pz.Bef.Wg. Panther *Ausf*. G throughout 1944 and into early 1945

7 Panther *Fgst.Nr.* 120360 and *Fgst.Nr.* 120404 completed by M·A·N in May 1944 were issued to I./SS-Pz.Rgt. 12 both had this early pattern of hinge and lever.

8 A small number of Panther *Ausf.* G would continue to be completed by all of the assembly plants without the triangular lifting point up to mid September 1944.

Driver and Radio Operator's Hatches

① The tubular levers designed to assist the crew with closing the hatches were initially fabricated from steel tubing with a turned and milled section at the base. The fixed fulcrum section of the hinge welded and bolted to the inner face of the hatch only allowed the handles to travel through 90° from their stowed position. The fulcrum had a lug ② that stopped the travel of the lever so that when the hatch was open it stood vertically, this was quickly found to be unsuitable as the crew member needed to expose his torso in order to grasp this handle and close the hatch. This was modified on the initial production vehicles by grinding off the lug which allowed the lever to travel through 180° so that the crewman only needed to reach up from his seat to grasp the handle and close the hatch.



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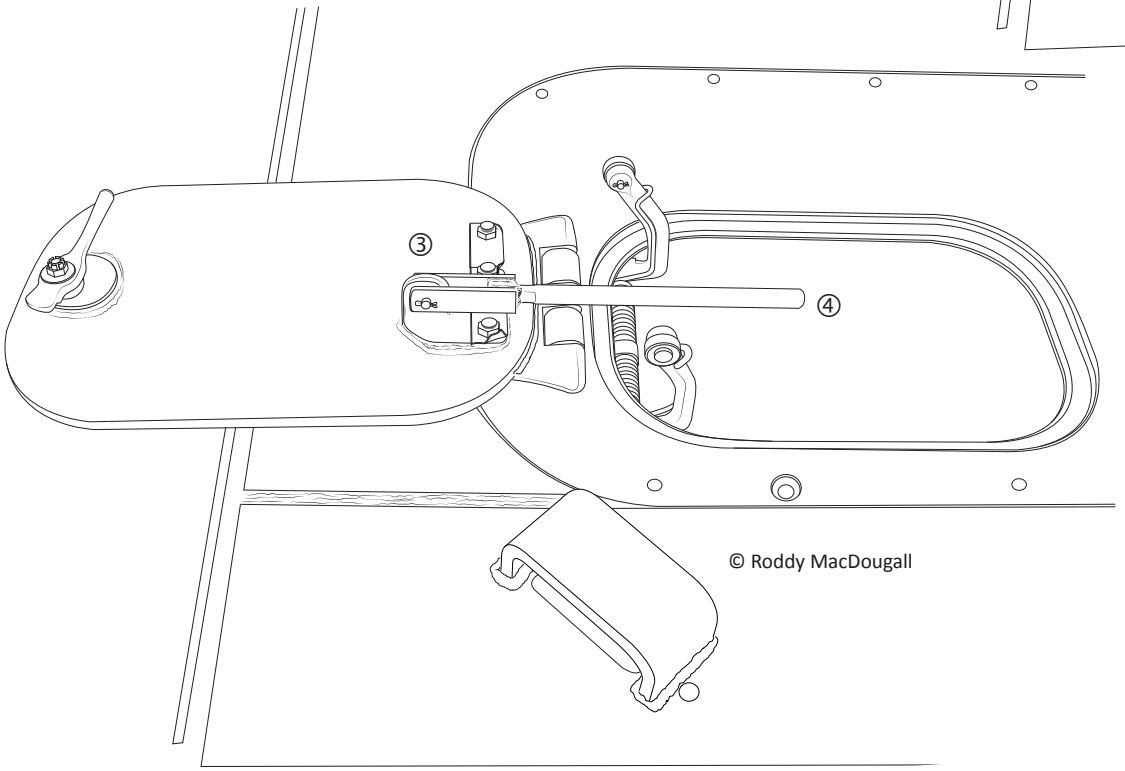

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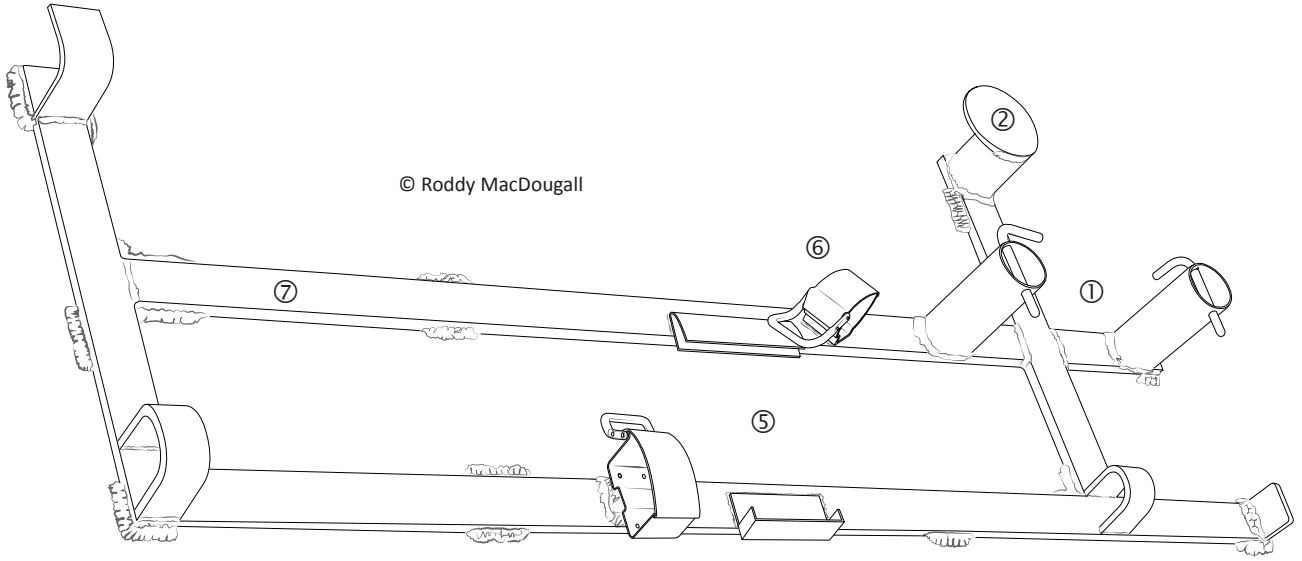
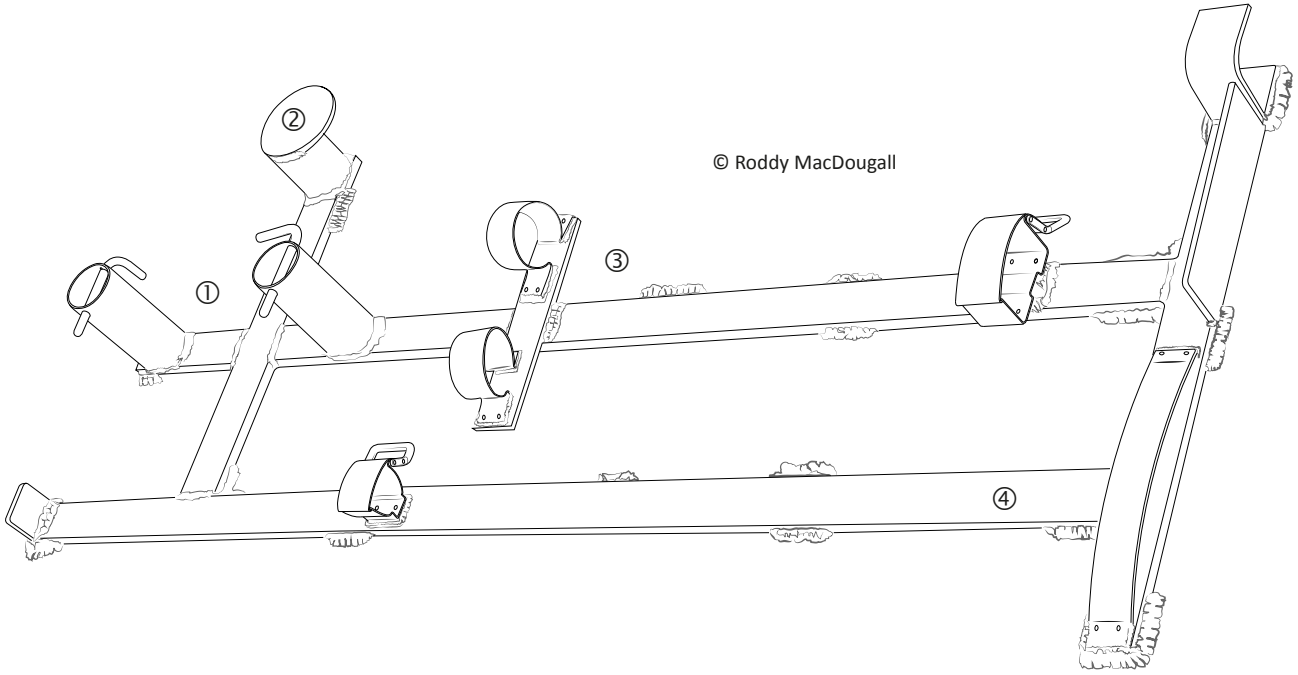
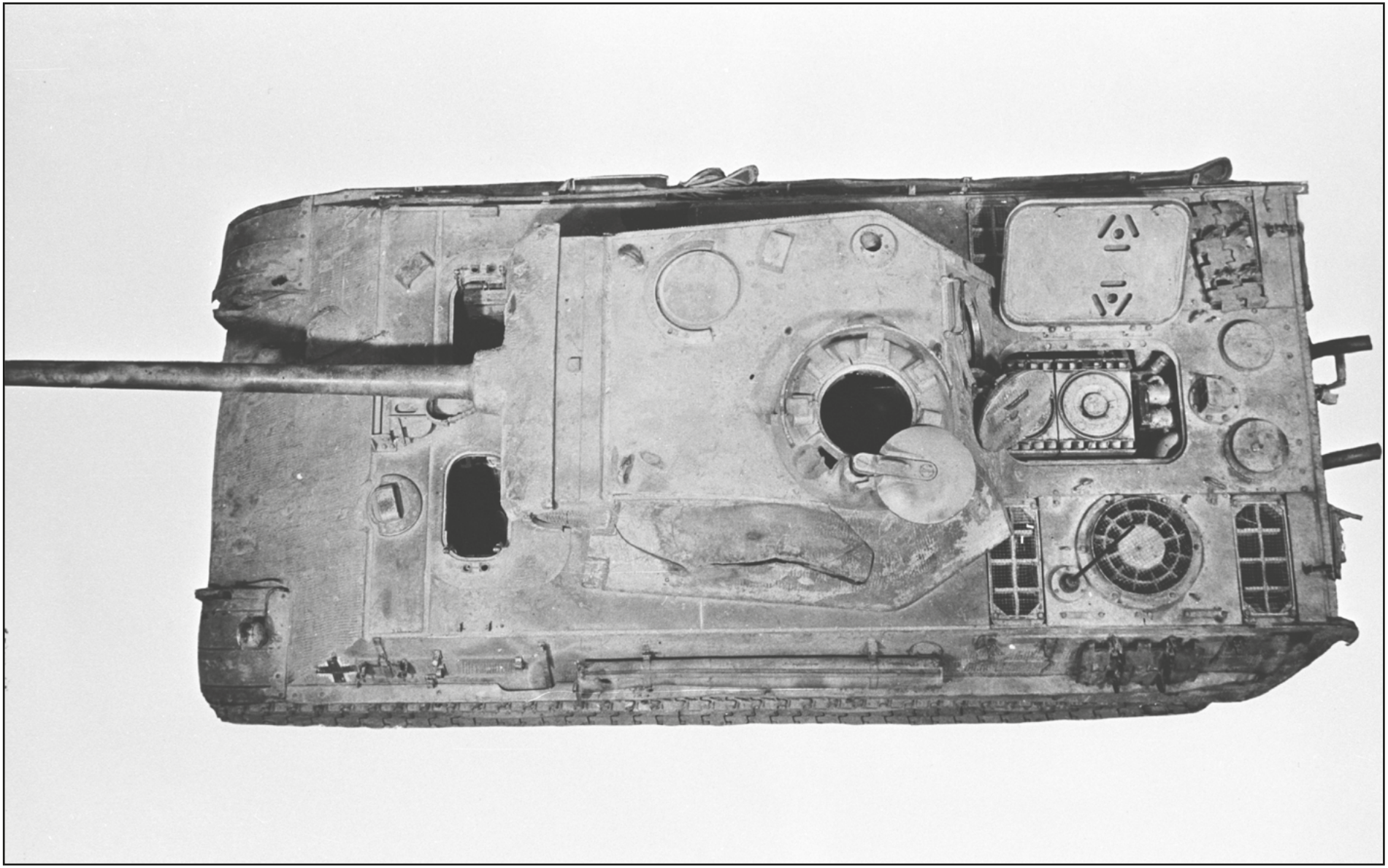
③The internal section of the hinge was redesigned (Drawing PV-G 520) replacing the lug with a radius that allowed the revised ④ tubular lever used by the crew to assist in closing the hatch to travel through 180°. The new handle was simplified so that it was fabricated from flat steel stock welded to the steel tubing. This was designed so that its forks applied enough friction to prevent the handle from dropping down and injuring the crewman below it. There would be a further additional amendement to the design in the last weeks of the war which is covered on page 262.



Tool Stowage Racks

The tool stowage racks fitted to the *Ausführung* G were originally designed for the Bergepanther. These were welded directly to the armour surface on the Wanne side. Both port and starboard side racks had ① posts for a towing clevis. The securing pins had a small lug that had to align with a corresponding notch in the post before it could be withdrawn and the clevis removed. ② A shortened post with a circular cap was mounted above this to secure one end of the tow cable when not in use. The port rack had brackets for mounting ③ a wire cutter and ④ a shovel. The starboard rack had brackets for ⑤ an axe as well as ⑥ a hand crank for the vehicle's manual starter. ⑦ A further bracket for the vehicles Tetra fire extinguisher was bolted to the rear of the upper horizontal strap on this tool rack. Owing to the complexity of this bracket it is shown separately on page 143.





M·A·N would fit jettisonable hatches for the driver and radio operator on the Panther *Ausführung* G from the start of series production. The original design drawings that were prepared prior to production getting under way did not include this feature, however all of the Ausführung G Panthers issued to the troops were fitted with the revised design. These hatches were present on the Ausführung G Panthers issued to both I./SS-Pz.Rgt. 12 and I./SS-Pz.Rgt. 1 in May 1944. Panther *Fgst.Nr.* 120360 and *Fgst.Nr.* 120404, shown above, completed by M·A·N. in April 1944 were both fitted with jettisonable hatches. The fulcrum section of the hinges had substantial pegs that went through two corresponding holes in the driver and radio operators roof plate. These were secured by an internal quick release clamp that allowed the whole hatch to be thrown clear of the vehicle in an emergency. It also has timber dampers on the *Fahrgestell* roof to cushion the hatch when this was opened, the port side damper was lost during following its capture but the starboard side damper can be seen between the radio operator's hatch aperture and the edge of the *Fahrgestell*. (Tank Museum, Bovington 2902-D2)

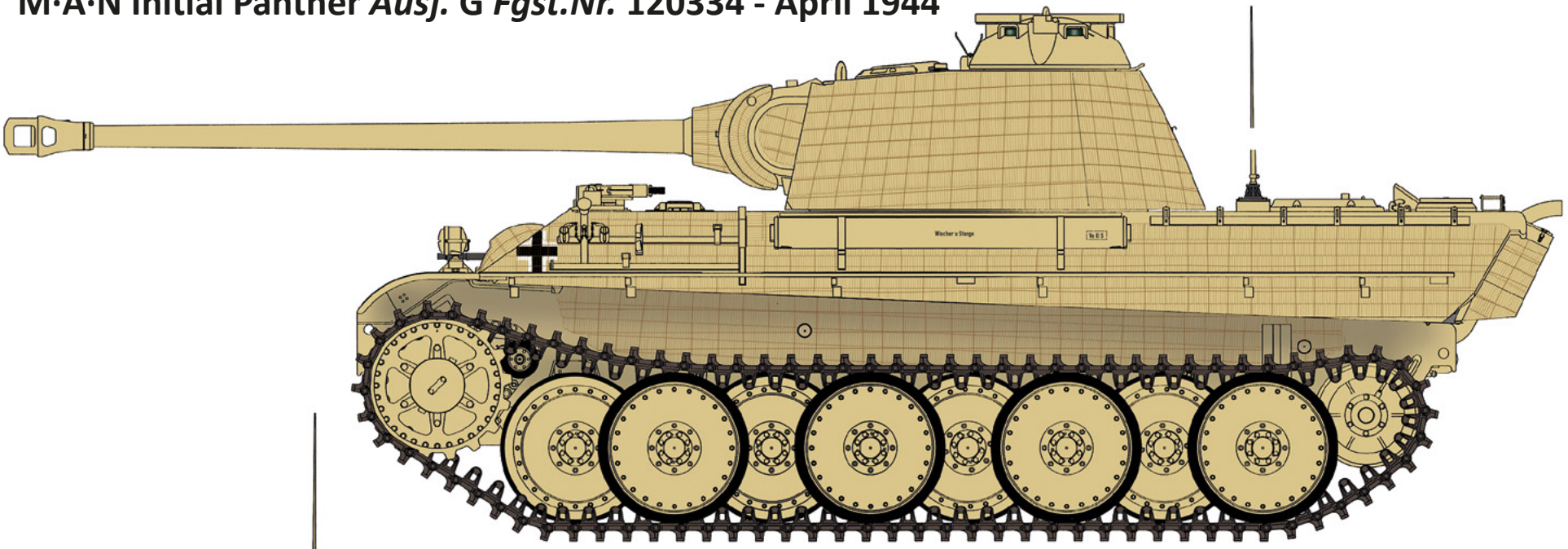
Panther Ausführung G Fgst.Nr. 120404 was issued to 1./SS-Pz.Rgt. 12 and had the tactical number 135 (Ustuf. Karl-Willi Dietrich). It was knocked out during a failed night attack on 8th/9th June 1944 at Bretteville-L'Orgueilleuse in Normandy. This Panther is the 104th series production Ausführung G and was completed by M·A·N on or around 30th April 1944. It has all of the features present on series production Ausführung G issued to front line units since the start of production. It had the early pattern of internal hinges and levers for driver and radio operator's hatches that were modified to allow the levers to travel through 180° as seen here. The port side timber bump stop can be seen underneath the drivers hatch. The majority of the tool stowage is still present but it would appear that the internal tool tray in the gun cleaning tools tube has already been liberated. (Crown BHC)

The cast armoured exhaust elbows are the same design as those used on the *Ausführung* D and A. The redesigned engine bay has eliminated the need to the two *Auspuffkühlung* pipes on either side of the port exhaust stack. The vehicle has been given a coating of *Zimmerit* paste on all of the exposed vertical armour and sheet metal surfaces using the same tools and methods as previously used on the *Ausführung* A Panther completed by M·A·N. A close examination of the port side *Gepäckkasten* reveals that the employee who applied the *Zimmerit* coating to this component ran the roller used to apply the surface texture in several directions so that some of the *Zimmerit* has a diced texture. The Notek convoy light fitted to the rear of this Panther is not the type normally used on the Panther. The vehicles jack has come out of the lower mounting bracket which is directly above the circular motor cover. This cover was also used on the *Ausführung* A Panther and has the integral centrally mounted tow coupling. Following its capture by Canadian forces this vehicle was returned to the United Kingdom where it underwent extensive technical evaluation at Bovington camp in Dorset. It would eventually be expended on the firing range during tests conducted to determine the combined ballistic properties of the armour and the vehicle's design. (Crown BHC)

Some of the early *Ausführung* G Panthers were issued to five of the units that took part in the Normandy campaign. This particular Panther was completed by M·A·N in May or June 1944, it has *Pilze* sockets for the 2ton *Behelfskran* mounted on the *Turm* (turret) roof and a full coat of *Zimmerit* paste on all of the vertical armour surfaces and sheet metal components finished in the distinctive ridged surface texture unique to Panthers completed by M·A·N. The radio operator's hatch has been jettisoned as it was blocked from swinging open by the angle of the *Turm* traverse. This Panther was issued to I./SS-Pz.Rgt. 1 and was lost in the Mortain sector. The handle on the jack block can just be seen above it, this was normally folded flat when the block was stowed in its bracket as it protruded above the height of the *Fahrgestell* roof and the *Turm* could easily catch this when it was traversed. (NARA via Darren Neely)

Another one of the early *Ausführung* G Panthers that took part in the Normandy campaign. This particular Panther was completed by M·A·N in April or early May 1944, it has a full coat of *Zimmerit* paste finished in the distinctive ridged surface texture applied by M·A·N. It has no *Pilze* sockets for the 2ton *Behelfskran* mounted on the *Turm* (turret) roof. The. This Panther was issued to 1./SS-Pz.Rgt. 9 and was lost at St. André-sur-Orne during operation "Goodwood". The good condition of the Schürzen rail on this vehicle indicate that it had not seen much active service prior to its loss as these sheet metal components were very easily damaged either in combat or while moving through dense vegetation. This Panther may have been destroyed by the crew using the demolition charge issued with the vehicle that was intended to ensure it was not captured intact by enemy forces as it has suffered a chatastrophic internal explosion. (Crown BHC)

M·A·N Initial Panther *Ausf.* G *Fgst.Nr.* 120334 - April 1944



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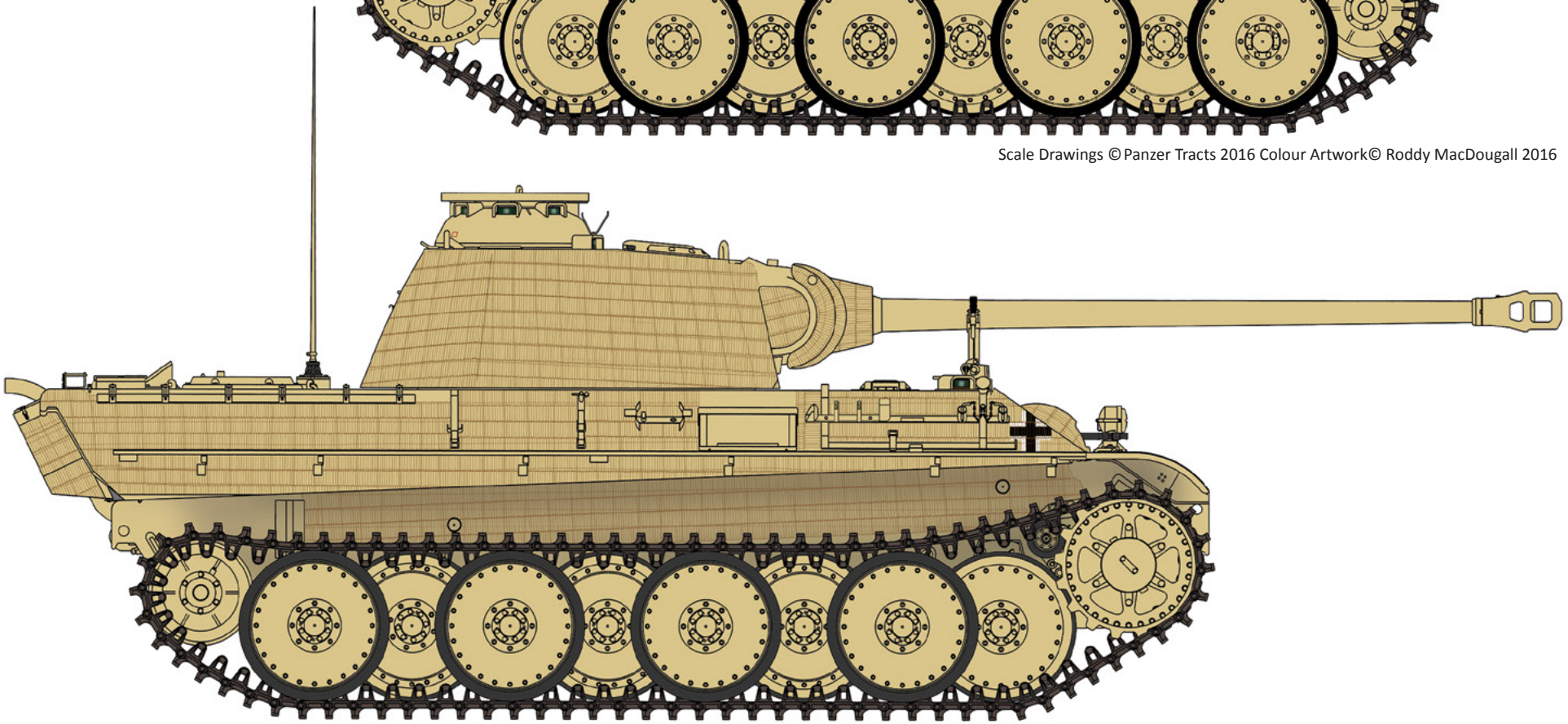

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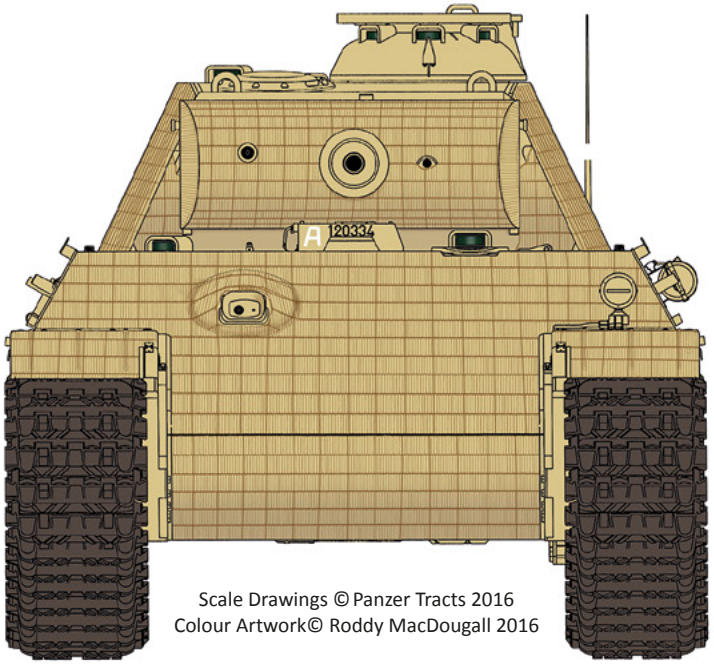

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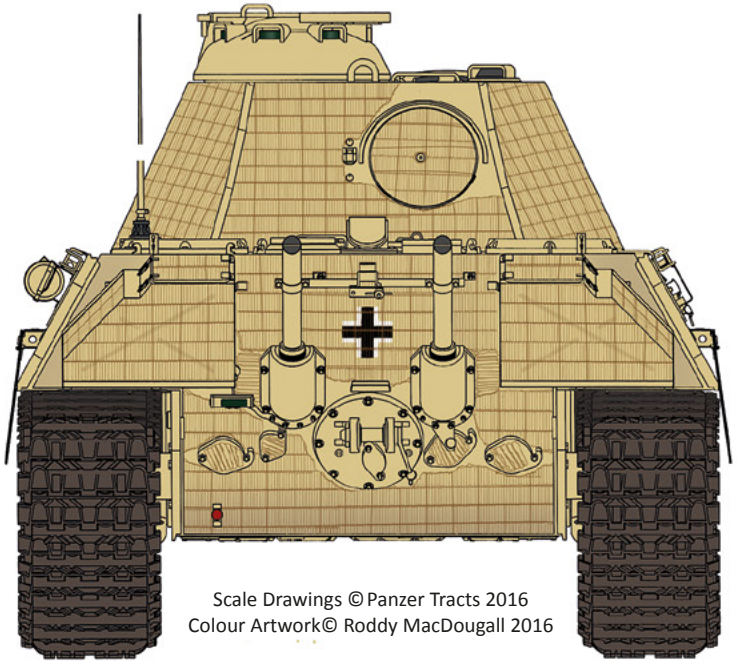

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Panther *Fgst.Nr.* 120334 was the 34th Panther *Ausführung* G assembled and is representative of all of the early vehicles completed by M·A·N and accepted for service with the *Wehrmacht* by the *Heeres-Abnahmestelle*. The vehicle was given a full coating of *Zimmerit* anti magnetic paste on all of the exposed vertical armour and large sheet metal components such as the fenders and *Gepäckkasten* (rear stowage box) but excluding the cast armoured exhaust elbows. The *Fahrgestell* number 120334 has been applied in black to the gun travel lock using *"Preußische IV 44 Ausgabe 3"* stencils. The roughly painted flat topped "A" applied to M·A·N vehicles indicating their acceptance by the *Heeres-Abnahmestelle* inspectors has also been applied to the gun travel lock. In accordance with the instruction *"O.K.H. (Ch H Rüst u. BdE), 3.2.1943 - 72d50/54 - In 2(IId): Nr. 181 in Allgemeine Heeresmitteilungen, 10. Jahrgang, 5. Ausgabe vom 22. Februar 1943"*, the vehicle was completed in an overall coat of *Dunkelgelb* RAL 7028 and would be issued along with tins of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 acrylic paste concentrate for the vehicle's unit Werkstatt or crews to apply camouflage locally. The location of the *Balkenkreuze* (beam crosses)national markings applied at the assembly plants after the Panther's acceptance by the *Heeres-Abnahmestelle* are now consistently painted in the same location for each of the assembly plants from the start of series production of the *Ausführung* G. The *Balkenkreuze* applied to Panthers assembled at the M·A·N plant in Nürnberg were applied to the front corners of the *Fahrgestell* (hull) just ahead of the tool stowage brackets on both the port and starboard side. The initial vehicles had the Balkenkreuze applied to the rear plate behind the vehicle's jack, this was very short lived however and did not last any more than a few weeks as it is barely visible in this location. The location for the rear *Balkenkreuz* was quickly moved to the starboard side *Gepäckkasten* (rear stowage bin). A significant number of *Pz.Bef.Wg.* Panthers had an alternative placement where *Balkenkreuze* were only applied to the sides of the *Türme* (turrets) with the rear plate bereft of this marking. This alternative arrangement does not appear to have been driven by the time frame of a vehicles assembly with both combinations appearing on *Pz.Bef.Wg.* Panther *Ausführung* G throughout 1944 and into early 1945.

May 1944

Daimler-Benz switched over to assembling the *Ausf.* G in May 1944, the initial vehicle that came off their assembly lines incorporated the modifications already introduced at M·A·N. Further modifications and design modifications were implemented to production, sheet metal guards were fitted around the exhaust stacks were introduced, these helped to protect the troops from the very high surface temperatures of the exposed exhaust as well as helping to reduce the glow from these at night. A new welded armoured exhaust guard was introduced at M·A·N.

The method of application and texturing as well as the areas covered with *Zimmerit* paste by Daimler-Benz on the *Ausf*. A continued when production switched over to the *Ausf*. G with two exceptions. The cupola was no longer given a coating of *Zimmerit* by Daimler-Benz. This had only been applied intermittently during production of the *Ausf*. A but this now ceased completely. The first vehicles delivered to the troops by Daimler-Benz had a coating of *Zimmerit* paste on the cast armoured guards and sheet metal guards for the exhausts. This practice was very short lived at Daimler-Benz and did not last more than a few weeks. None of the assembly plants involved in the Panther programme had previously coated the armoured exhaust guard with *Zimmerit* when assembling the *Ausf*. A, M·A·N had started to coat the welded armoured exhaust guards that it fitted with *Zimmerit* and would continue to do so until the instruction to apply this coating to armoured vehicles was rescinded in September 1944.

Daimler-Benz delivered their first *Ausführung* G Panthers with the jack block designed to fit the *Ausführung* A tool brackets. Daimler-Benz assembled Panther *Ausf.* G had the bracket for the track changing cable welded vertically to the *Wanne* side as opposed to the horizontally mounted brackets on Panther *Ausführung* G assembled by M·A·N they would continue to weld this bracket vertically until July. Daimler-Benz would apply the *Balkenkreuze* national markings to the port rear *Gepäckkasten*, the centre of the wire cutter tool stowage bracket on the port side and centrally between the hammer tool stowage brackets on the starboard side. M·A·N and Daimler-Benz would start to modify the armoured ventilator cover on the *Wanne* roof by removing a crescent shaped section to allow the curved section of the gun travel lock to clear the edge. The initial *Ausf.* G Panthers completed by M.N.H. would also use the original unmodified design or this component[9].

June 1944

On 10th May the *Heeres-Waffenamt* had written to the assembly firms regarding some of the components that were being used in the *Feuerlöscheranlage* (fire extinguisher system) in the motor compartment.

"M·A·N has explicitly stressed that the T-pieces A18 DIN 71433 necessary for the fire extinguisher system need to be installed in cast steel as per the specifications. In no case is it allowed to use die cast T-pieces, as this material does not comply with the requirements as it would melt if a fire broke out near a T-piece rendering the fire extinguisher useless."

The *Heeres-Waffenamt* would then be forced to write to the assembly plants regarding these T-pieces on 6th June:

"We refer to our memo from 10th May concerning the installation of T-pieces in cast steel. M·A·N has informed us that the T-pieces in cast steel will not be available for another 8-9 months. Until then it will be necessary to install T-pieces made from die cast Zink."

A large number of the Tetra 2 Litre. *Feuerlöscher* (fire extinguishers) had been damaged in transit, a lengthy memo was sent out regarding these on 13th June detailing the repair procedures for these. Repair and recharging facilities were to be set up at the plants to deal with these. This was slightly complicated by the introduction of *Feuerlöscher* (fire extinguishers) charged with Bromochloromethane manufactured by the firm Minimax rather than Tetra chlorine-carbon (also known as Tertracloromethane) that had previously been used and from which the firm Tetra derived its name. Tetra chlorine-carbon liquid vaporized and extinguished the flames by inhibiting the chemical chain reaction of the combustion process but produced highly toxic by-products when discharged onto a fire that was a concern when used in enclosed spaces such as a tank or aircraft. Some of these new Bromochloromethane *Feuerlöscher* (fire extinguishers) would also need to be repaired which required an element of duplication at the repair station. The *Heeres-Waffenamt* instructed the assembly plants to remove any Tetra chlorine-carbon *Feuerlöscher* (fire extinguishers) which were marked in blue that had been fitted to the vehicle's interior and use these for the externally mounted *Feuerlöscher* (fire extinguishers).

A further instruction was sent regarding the installation of the *Laufradkurbeln* (road wheel swing arms) on 13th June 1944. The reinforced Siepmann swing arms did not make contact with the bump stop spring assembly's, this is a result of deformation that led to new guidelines for the installation of the road wheel swing arms:

For the *Ausführung* A

- Road wheel station 1. port and starboard, reinforced Siepmann swing arm 48393-40
- Road wheel station 2. port and starboard, reinforced Bochumer-Vereins swing arm 48393-14
- Road wheel station 7. port and selected starboard road wheel stations, reinforced Siepmann swing arm 48393-15 For the *Ausführung* G

9 Panther *Fgst.Nr.* 128303 completed in July 1944 has the original ventilator armour design.

This M·A·N assembled Panther *Ausführung* G was part of a column of new Panthers from 3./SS-Pz.Rgt. 12 that were photographed at the Arc de Triomphe while transiting Paris on 24th June 1944. They are painted in a camouflage scheme that for ease of identification we will call the "leopard spot" scheme. This consisted of an overall coat of *Dunkelgelb* RAL 7028 that had fields of *Olivgrün* RAL 6003 that are completely encircled by a *Rotbraun* RAL 8017 border sprayed with diffuse edges. There is little doubt that the Panthers painted in this scheme that were part of the column transiting Paris were painted by the crews or unit Werkstatt. The camouflage obscures some of the factory applied markings such as the *Balkenkreuze* and shipping labels on a number of these Panthers. There were almost certainly guidelines regarding the use of this scheme which appears to have been trialled during early summer 1944 as there are photographs of numerous different vehicle types serving with several units on both the Eastern and Western Fronts that were finished in this scheme. There are photographs of both *Ausführung* A and G Panthers from Pz.Brig. 101 completed in this camouflage scheme taken in the summer of 1944 just prior to this unit being commited to action. These vehicles should not be confused with those Panthers completed a few weeks later at the end of July and subsequently issued to Pz.Abt. 2105 in August. However, in all probability the Panthers issued to Pz.Abt. 2105 were also part of an isolated trial. There is photographic documentation of this scheme being applied to vehicles either by a crewman or a member of the unit *Werkstatt* company in the summer of 1944. It is all the more remarkable as it was taken on the Eastern front which is not s theatre of operations typically associated with this camouflage scheme. (Bundesarchiv 101I-721-0395-22, KB Janke)

Panther Fgst.Nr. 124317 was completed on or about 14th May 1944 and is the 17th Ausführung G built by Daimler-Benz. It has all of the features incorporated into the new design up to that point including jettisonable hatches for the driver and radio operator and wooden dampers for these hatches on the *Fahrgestell* roof. It has been fitted with Pilze sockets for a 2ton Behelfskran on the Turm roof; this was possibly done by the unit Werkstatt who have also fitted, hooks for mounting spare tracks on the Turm sides, threaded bolts for carrying spare road wheels on the rear quarters of the Turm and two different types of debris guard that they fabricated over the gun mantle during its service life. The type seen in this photograph is similar to the standard model introduced to series production vehicles completed by Daimler-Benz at the end of August but is secured using bolts in threaded sockets welded to the top of the trunnion armour. The mounting points for the older debris guard can be seen on the rear edge of the trunnion

armour casting just ahead of the weld seam with the Turm roof. The vehicle was originally issued to I./Pz.Rgt. 24 and saw service in Normandy prior to being transferred to I./Pz.Rgt. 16 in November 1944, it still has the tactical number 111 in the plain white digits typically used by I./ Pz.Rgt. 24 on their Panthers. This Panther was knocked out while attempting to cross the bridge over the River Ourthe during the Ardennes Offensive in December 1944. It rolled into the river where it landed on its roof. It was recovered some time later and now serves as a war memorial in the centre of the town. (2x Georges Son via Jean-Michel Delvaux)

- Road wheel station 1. port and starboard, reinforced Siepmann swing arm 48393-40
- Road wheel station 2. port and starboard along with 7. port and 8. starboard, reinforced Bochumer-Vereins swing arm 48393-14
- All other road wheel stations were to be fitted with the normal hollow 48303-30 swing arms from the manufacturer Siepmann.

Abt.4111 who were responsible for purchasing for the Panther programme were tasked with obtaining sufficient additional reinforced Bochumer-Vereins-*Kurbeln* (swing arms) 48393-14 to replace the defective components.

Instructions were issued to the assembly plants in June 1944 to ensure that *Pilze* sockets for a 2ton *Behelfskran* were fitted to the *Türme* roofs and instructions were sent to unit *Werkstatt* personnel authorising them to retrofit these to Panthers assembled earlier. This change was driven by the delivery of *Türme* completed to *Ausführung* G specification by the armour manufacturers who were responsible for welding all of the components other than those fabricated out of sheet metal to *Türme* and *Wannen* prior to the hardening process. As a result of this the assembly plants had a supply of *Türme* with this design feature available immediately prior to the official instruction enabling M·A·N and Daimler-Benz to complete vehicles with this design change in May 1944. A few vehicles were back fitted by unit *Werkstatt* personnel as was the case with Panther *Fgst.Nr.* 124317 completed in mid May and issued to I./Pz.Rgt. 24. There is little evidence of this modification having been widely implemented by either the troops or the assembly plants on *Ausführung* D or A Panthers. Panther *Ausführung* A *Fgst.Nr.* 155597[10] was completed by M.N.H. on or about 25th June 1944 without *Pilze* sockets. A single photo of a factory reworked *Ausführung* A that was photographed at a proving ground or training area is the only evidence that has surfaced to date of *Pilze* sockets fitted to either the *Ausführung* D or A. It should be remembered that even though these vehicles represented a significant contribution to Germany's war effort the firms involved in their production were also commercial organisations driven by profit and bound by contracts so would not modify a design unless instructed and paid to do so. Any unauthorised modifications made would in any case be rejected by the *Heeres-Waffenamt* inspection team during the *Heeres-Abnahmestelle* procedure.

Some Units had started to weld a handle to the external face of the loader's hatch on the *Turm* in response to conditions in the field where the hatch was difficult to open particularly when wearing gloves or mittens and did not sit properly[11]. A handle was introduced to production by the assembly plants in June and units were authorised to retrofit this to Panthers assembled earlier. It should be noted that not all of the modifications authorised to be made by units were implemented by all of the units or all of the Panthers within a unit that had carried out modifications. This was also the case with modifications implemented by the troops at their own volition such as installing hooks or brackets for carrying spare track links on the *Turm* sides or spare road wheels.

M.N.H. were gearing up for the changeover from assembling the Panther *Ausführung* A to the new *Ausführung* G series that was scheduled to take place in July. On 28th June the *Heeres-Waffenamt* wrote to them regarding the *Lüfterkupplung* (fan clutch assembly, drawing 021 St 48329-188) for the new *Ausführung* G which was prone to slipping caused by the small size of the ball-bearings and the limited pitch of the ball bearing race. This led to a lack of airflow over the radiators and high motor temperatures. A new race with a 25° pitch and larger 15mm ball-bearings was ordered to be installed in the redesigned *Lüfterkupplung* (fan clutch assembly 021 St 48329-188) from the 1st *Ausführung* G vehicle to be completed by M.N.H., vehicle 1051, *Fgst. Nr.*128301 onwards. M.N.H. reported on 26th June that they had 50 redesigned clutches in stock and 80 more are on the way. The remaining (old) clutches with the small ball bearings and limited race pitch were to be sent back to Argus-Motorenwerke, Karlsruhe to be reworked. Because the troops had also been ordered to the change the older model to the new fan clutch, the assembly plants are ordered to add a red-cross in waterproof paint on the cover of the clutch to indicate that the change to the new clutch has already been made. This would be one of a series of communications over the next few weeks that were intended to ensure that all of the design modifications introduced since the original set of drawing and instructions for the *Ausführung* G were sent to M.N.H. would be present on these vehicles when deliveries of series production *Ausführung* G Panthers commenced in July.

The *Heeres-Waffenamt* wrote to M.N.H. on 27th June to ensure that the bearing housing (021 St 51111 U2) for the cardan shaft on the inertia starter was filled with oil. A new closure screw BM 10x1 DIN 7604 would soon be available, however until then they were allowed to use the current lubrication button. They were ordered to fill the requested housing with oil from the first *Ausführung* G vehicle, vehicle 1051, *Fgst.Nr.*128301 onwards.

July 1944

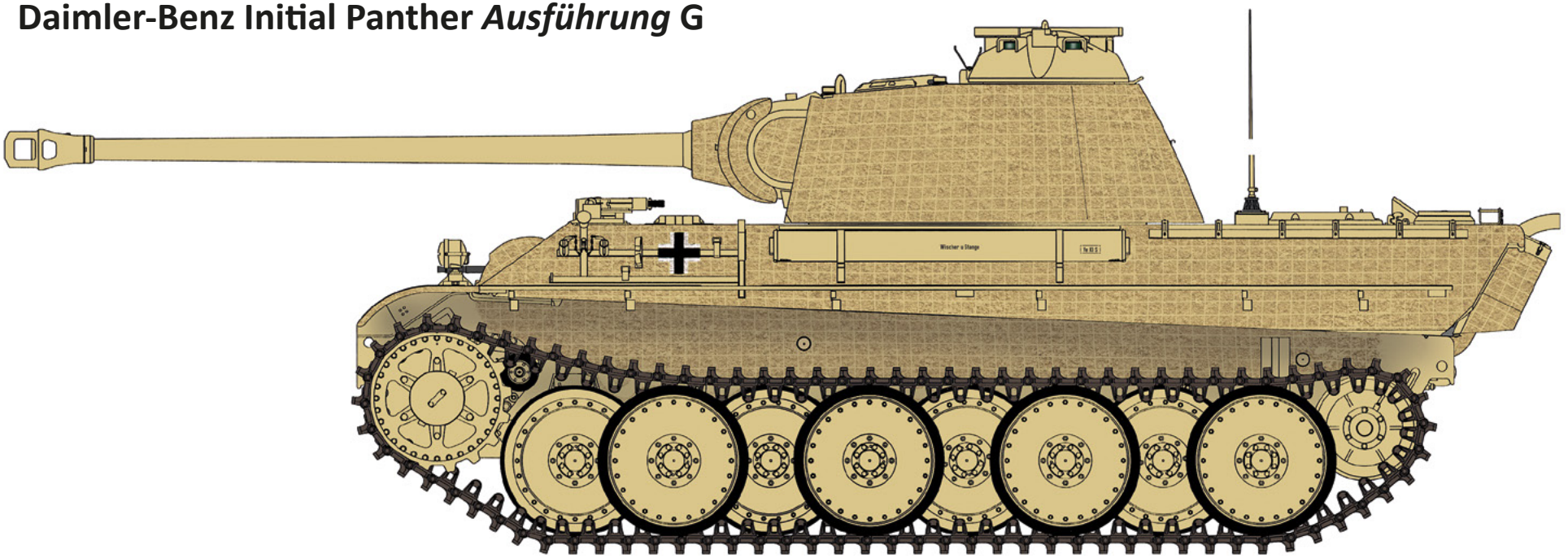
The *Heeres-Waffenamt* wrote to the assembly firms on 4th July regarding problems the troops had encountered with the motor cooling system on a number of new Panthers. The *OKH* points out that the problems were mainly due to damaged heat exchangers fins. These damaged fins reduce the performance of the cooling system by 15% and prevent it from working properly by reducing the air flow through the unit. They went on to say the number of damaged heat exchangers occurring lately

10 Panther *Fgst.Nr. 155506* completed on or about 2nd June 1944, currently on display at Saumur and Panther *Fgst.Nr.* 155597 completed on or about 25th June 1944 captured from I./Pz.Rgt. 6 in Paris and now on display Mourmelon-le-Grand.

11 An example of this is a Panther from I./Pz.Rgt. 31 abandoned at Uman, the Ukraine in March 1944 as seen on page 89.

Three almost new Daimler-Benz assembled Ausführung G Panthers from II./Pz.Rgt. 23 in the Abteilung's Werkstatt facilities on the Eastern Front in August 1944. Daimler-Benz would apply the Balkenkreuze national markings to the port rear Gepäckkasten, the centre of the wire cutter tool stowage bracket on the port side and centrally between the hammer stowage brackets on the starboard side of the *Fahrgestell*. They were given a full coat of Zimmerit on all of the vertical armour and sheet metal surfaces including the sheet metal guards on the exhaust stacks and the cast armoured exhaust elbows. The ridges in the foundation coat of Zimmerit are more prominent on the Ausf. G Panthers than those typically visible on the Ausf. A completed by Daimler-Benz. There was no change to the external appearance of the Ausfuhurung G Panthers completed by Daimler-Benz and accepted for service with the Wehrmacht from the start of series production until August 1944. (Bundesarchiv 101I-244-2323-25A)

Daimler-Benz Initial Panther *Ausführung* G



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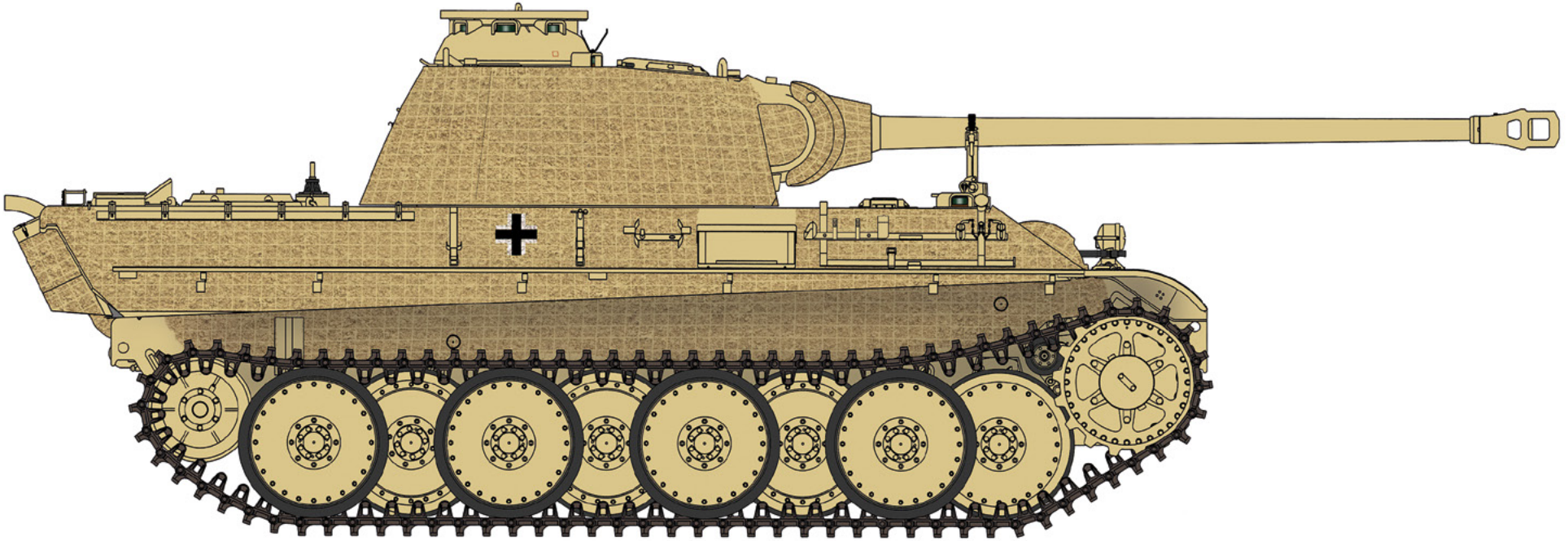

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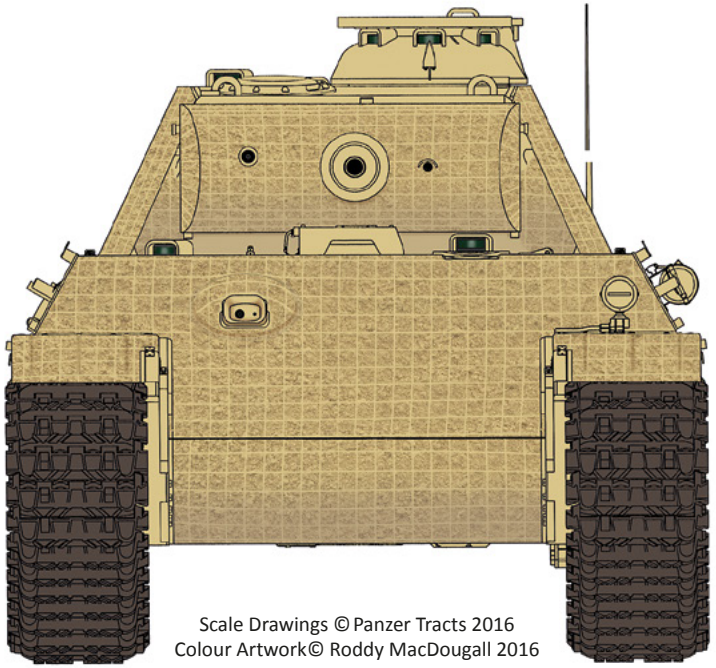

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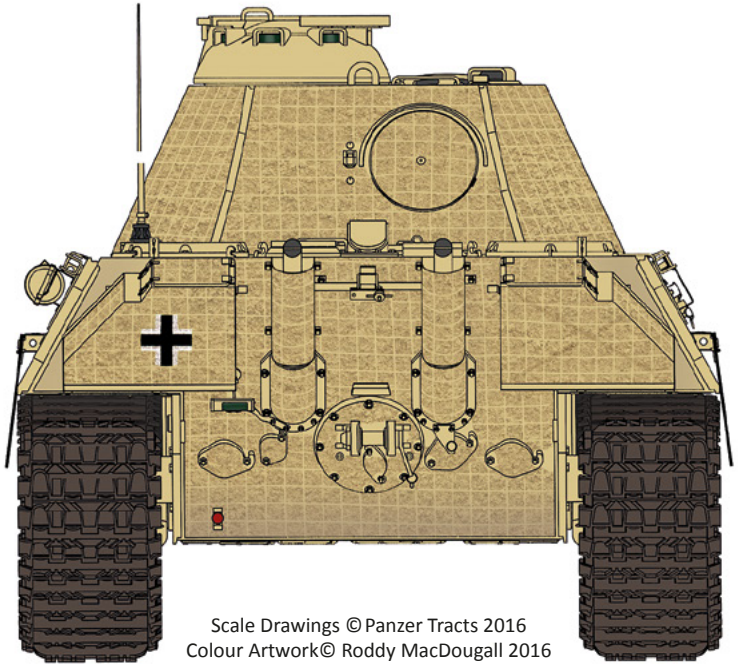

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Daimler-Benz would commence series production of the Panther *Ausführung* G at its *Werke* 40 facility at Berlin, Marienfelde in May 1944. The vehicle depicted in the plate above is representative of the early *Ausführung* G Panthers completed by Daimler-Benz. The vehicle was given a full coating of *Zimmerit* anti magnetic paste on all of the exposed vertical armour and large sheet metal components such as the fenders and *Gepäckkasten*. This would also include a coating on the cast armoured exhaust elbows and the sheet metal guards around the exhaust stacks which is unique to Panthers assembled by Daimler-Benz. There is no *Fahrgestell* number visible on the vehicle's exterior though these were intermittently applied up to mid September. There was no change to the instructions regarding the exterior paint finish so the vehicle was completed in an overall coat of *Dunkelgelb* RAL 7028 and would be issued along with tins of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 acrylic paste concentrate for the vehicle's unit *Werkstatt* or crews to apply camouflage locally. As mentioned in the text accompanying the colour plates for the M·A·N Panther *Ausführung* G on pages 118-119. The location of the *Balkenkreuze* national markings applied at the assembly plants after the Panther's acceptance by the *Heeres-Abnahmestelle* were consistently painted in the same location at each of the assembly plants during series production of the *Ausführung* G. The location of the *Balkenkreuz* marking applied to *Ausführung* G can be used to identify which plant assembled a particular vehicle in period photographs. Daimler-Benz would apply the *Balkenkreuze* national markings to the port rear *Gepäckkasten*, the centre of the wire cutter tool stowage bracket on the port side and centrally between the hammer tool stowage brackets on the starboard side of the *Fahrgestell*. There would be some changes to the location of these markings in late 1944 which will be discussed later. Note that Daimler-Benz fitted the track changing cable stowage bracket vertically at this time on the starboard side of the *Fahrgestell*.

Daimler-Benz completed a number of I.R. prepared Panthers in July that were issued to I./Pz.Lehr-Rgt. 130 who were attached to Pz.Brig.113. These vehicles were initially delivered in an overall coat of Dunkelgelb RAL 7028. They were later repainted in camouflage schemes by the vehicles crew or more likely the unit Werkstatt using the dilutable Rotbraun RAL 8017 (red brown) and Olivgrün RAL 6003 (dark olive green) camouflage paste issued and then had the Balkenkreuze national markings reapplied to the Turm sides for the unit's activation parade. This photograph was taken outside Réchicourt-la-Petite and shows one of these I.R. prepared Panthers from I./Pz.Lehr-Rgt. 130 after it was knocked out on 19th September 1944. These Panthers were issued without any FG 1250 equipment as its development and installation as a combat ready night vision solution in the Panther was not complete. It was to undergo several further redesigns before the end of the war. (MHI via Steve Zaloga)

Panther *Fgst.Nr.* 124593 was completed by Daimler-Benz on or around 24th July 1944 shortly after the first I.R. prepared Panthers had been completed. It was amongst one of the groups of Panthers issued to I./Pz.Rgt. 24 several weeks later in September. It has *Pilze* sockets on the Turm roof but no debris guard over the gun mantle. The aperture in front of the driver's periscope is the original rectangular cut design which would be phased out of production in the next few weeks. The periscope has been fitted with a unit *Werkstatt* fabricated sun visor that is unique to I./Pz.Rgt. 24 Panthers. Note the square cut aperture in the glacis plate for the drivers periscope. The Fgst. Nr. has been stencilled in white on the gun travel lock using the *"Preußische IV 44 Ausgabe 3"* font. I./Pz.Rgt. 24 were attached to 116.Pz.Div. for operations in Normandy and would remain with this Division until November 1944 when I./Pz.Rgt. 16 returned to their parent formation 116.Pz.Div. (MHI via Steve Zaloga)

could not only be related to well known shortages. The assembly firms were therefore ordered to repair the damaged heat exchangers prior to installing them and in view of the importance of installing efficient cooling systems, to carefully supervise these repairs. They also informed the assembly firms that transportation of the heat exchangers had to be carefully monitored in order to prevent damage to the fins in the first place.

The assembly plants were informed on 6th June 1944 that contrary to the previous decision communicated on 1st June it was decided today that the original *Seitenvorgelege* (final drive drawing 021 B 48376-77) with the rubber return rollers would continue to be used instead of the new design that used a *Gleitschuh* (skid shoe drawing 021 B 48376-18) in place of the roller. The memo went on to say that from 1st July 1944 on ca. 2600 sets of the old *Seitenvorgelege* (final drive drawing 021 B 48376-77) would start to be delivered and that the orders for the return rollers were to be issued accordingly.

From the start of production of the Panther series the *Kettennachstellung* (track adjustment spindle, drawing 48306/7 U1) has been secured with respect to the final adjusted position of the idler wheels by a cotter pin and collar assembly. The *Heeres-Waffenamt* wrote to the assembly firms on 26th June to inform them that a change to the design of this securing system was to be implemented in the form of a nut/thread solution. The vehicle's tracks stretched as they wore and the adjustment spindle would start to move at the final position of the idler wheels, resulting in knocked out cotter pins and collars on older vehicles. The change to the threaded spindle and securing nut system instead of the cotter pin and collar assembly was to be introduced as soon as possible. MIAG, Zschachwitz, had already delivered some of the redesigned spindles, so that this design change would be implemented on vehicle 1051, *Fgst.Nr*. 128301. M.N.H. were informed that the stock of old spindles were to be reworked in-house to the new design. The corresponding anchor nut 48306-76 was to be taken from part 48303-222, these would require the slots to be milled in them prior to being fitted. M.N.H. would report the *Heeres-Waffenamt* on 5th July that it was not possible to install the new track adjustment spindles with the threaded ends and securing nut from vehicle 1051, *Fgst.Nr.* 128301 onwards. The spindles that were delivered had the wrong thread and needed to be reworked. They had therefore used the old spindles up to and including vehicle 1069, *Fgst. Nr.* 128319. They did report that the new spindle design would be fitted to all new Panthers from vehicle 1070, *Fgst.Nr.*128320 onwards.

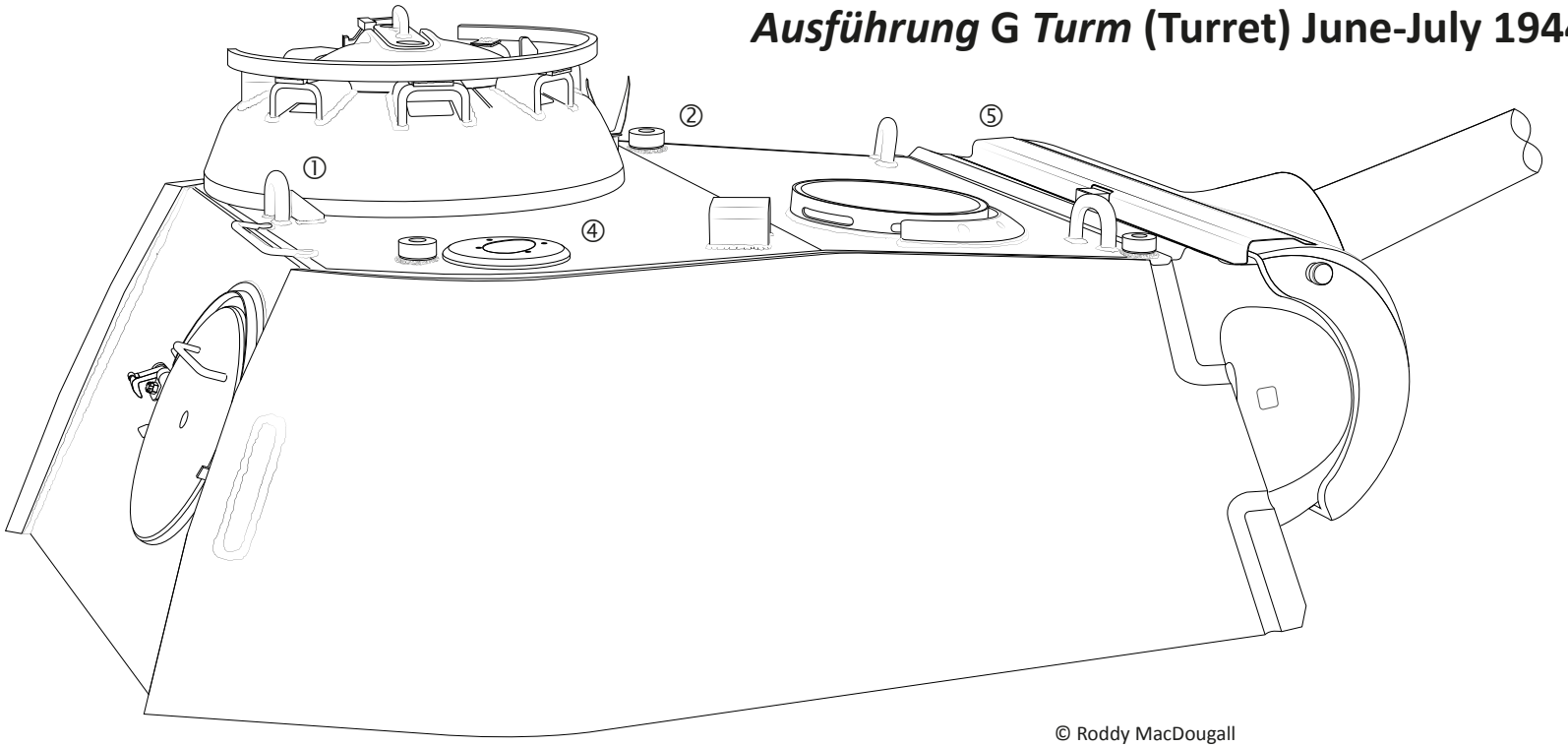
A further urgent design change was made on 8th July to two of the brackets (021 F 51102-31 and 32) in the driver's compartment that needed to be reworked immediately. They were to have apertures in the brackets for carrying the oil line cable to the oil pressure gauge. The stop (PV-G 417) on the cover for the driver's seat (021 D 51102 U 12) also needed to be reworked as this was used for the starter cable conduit.

The modifications necessary to enable the Panther's fuel system to be drained at the bottom of the motor compartment were also forwarded to the assembly firms on 8th July. The M·A·N design team had determined the most efficient method to be used as a temporary measure until purpose designed components were sourced. It was necessary to change the single piece 13mmx1800mm RoN 18107.2 hose (drawing number 021 E 51121-507) from the valve battery to the *Knechtfilter* (Knecht was the manufacturer's name), for one 13mm hose between 1120 and 1300mm in length with the same RoN specifications and one hose 13mmx750mm long also with the same RoN specifications joined by a 13 DIN 7610 T-piece with a type 7619 plug that would serve as the drain point. M.N.H. reported that they had 400 of the 13 DIN 7610 T-pieces in stock but would need to obtain the hoses. Abt.4111 was asked to report when these hoses would be available and to look for supplies of a suitable drain coupling that were needed for the connections. The assembly plants were also informed that the old hose (021 E 51121-507) was being discontinued and that this design change was to be introduced for Panthers completed in August. The *Heeres-Waffenamt* would need to amend these instructions on 20th July after Abt.4111 had reported that they would be unable to supply the correct hoses and T-pieces until February 1945. The assembly plants were informed that the original 13mmx1800mm hose (drawing number 021 E 51121-507) would stay in production and that the assembly plants were to use the components previously authorised as a temporary measure.

The *Heeres-Waffenamt* informed the assembly firms on 11th July that due to the shortage of the correct flange bolts (48329-125) for the *Lüfterantriebewelle* (fan drive shaft) the assembly firms were allowed to temporarily install bolts with an 8G tolerance due to the lack of bolts with the correct 10K tolerance. Since these bolts are subject to high stress loads, the assembly firms were to report the *Fahrgestell* numbers of the vehicles that received the 8G bolts and report these to Abt.703, so that these could be changed by the troops when the 10K bolts were available.

One of the more common modifications carried out by the units in order to resolve problems encountered when the Panther was in service was to fit a debris guard over the gun mantle. Falling masonry or large splinters from timber could become lodged between the gun mantle and the trunnion armour casting, this could put severe strain on the guns elevation mechanism or cause it to jam. There were several different patterns for these debris guards which were fabricated by the unit *Werkstatt*. In late June or early July 1944 M·A·N started to fit a sheet metal debris guard over the gun mantle as a standard design feature. The initial pattern was fastened via 2 sheet metal tabs that bolted to corresponding drilled and tapped mounting points welded to the trunnion armour casting. This was quickly changed to a simplified design that was tack welded directly to the trunnion armour casting along the rear edge of the guard, one of the Panthers with this design change, *Fgst.Nr.* 120734 completed in mid July, was issued to I./Pz.Rgt. 27 and was subsequently lost in the Studzianki area of Poland between 9th to 16th August 1944 where it was photographed. Panther *Fgst. Nr.* 120721 also completed by M·A·N with a debris guard and issued to I./Pz.Rgt. 27

Ausführung G *Turm* (Turret) June-July 1944



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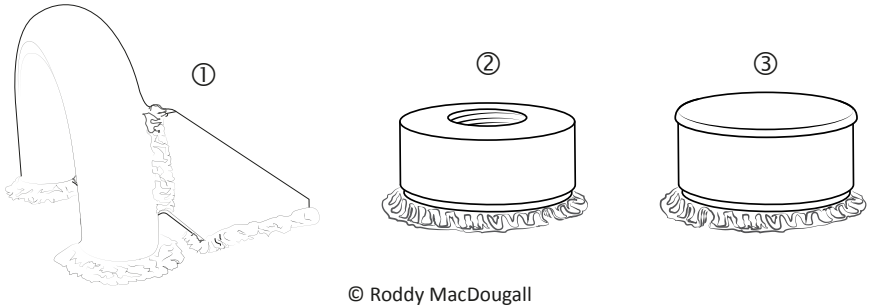
① There was only one minor alteration made to the *Türme* fitted to the *Ausführung* G from the design used on the Ausführung A, a small triangular brace was welded to the rear lifting point on the Turm roof. There is only a single example of *Pilze* sockets present on a Turm fitted to an M·A·N assembled Ausführung A completed before M·A·N commenced assembly of the *Ausführung* G series. ② *Pilze* were threaded sockets for the 2ton *Behelfskran* that were welded to the Turm roof from the middle of May 1944 on. The name *Pilz* (mushroom) is derived from the ③ cover for the socket that resembled the domed top of a mushroom. These are extremely difficult to find in period photographs, they are frequently missing from vehicles that have only just been delivered to the troops. All of the Türme fitted to *Ausführung* G were equipped with a ④ *Nahverteidigungswaffe* close defence weapon. ⑤ The sheet metal debris guard was first installed by M·A·N in late June or early July 1944. M.N.H. would not fit this guard to the initial *Ausführung* G it completed in July but would start fitting it to all of the Panthers they completed around the end of July or beginning of August. Daimler-Benz do not appear to have fitted the debris guard prior to the end of August 1944.



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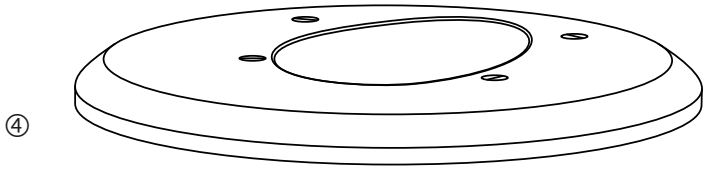
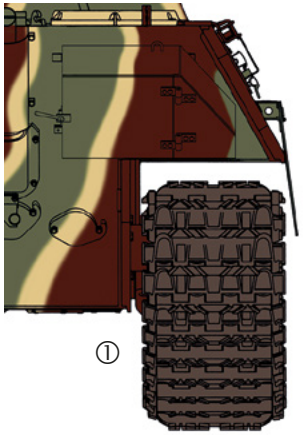
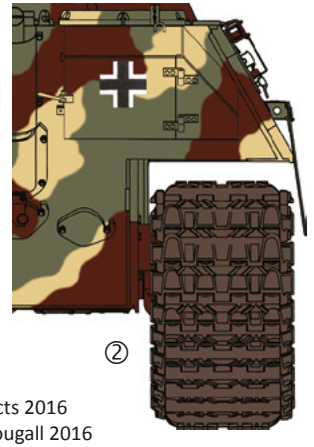


Infra Rot (I.R.) Armoured Stowage Box





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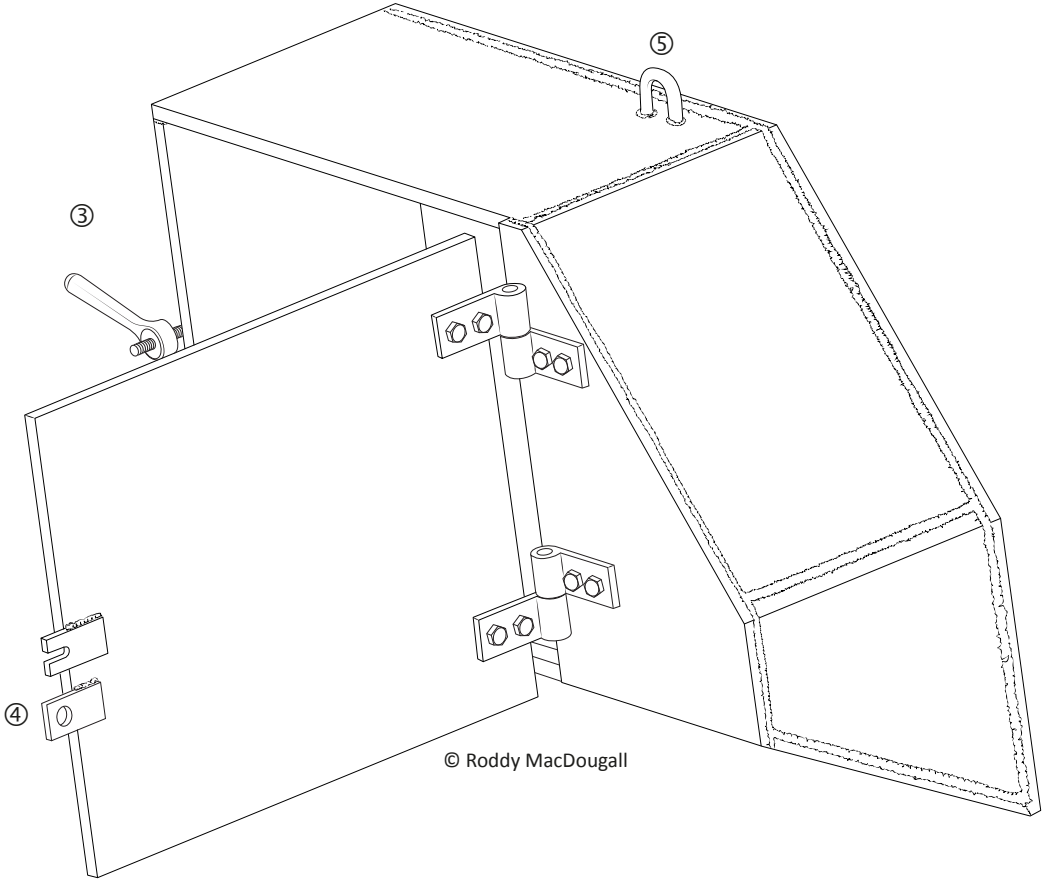
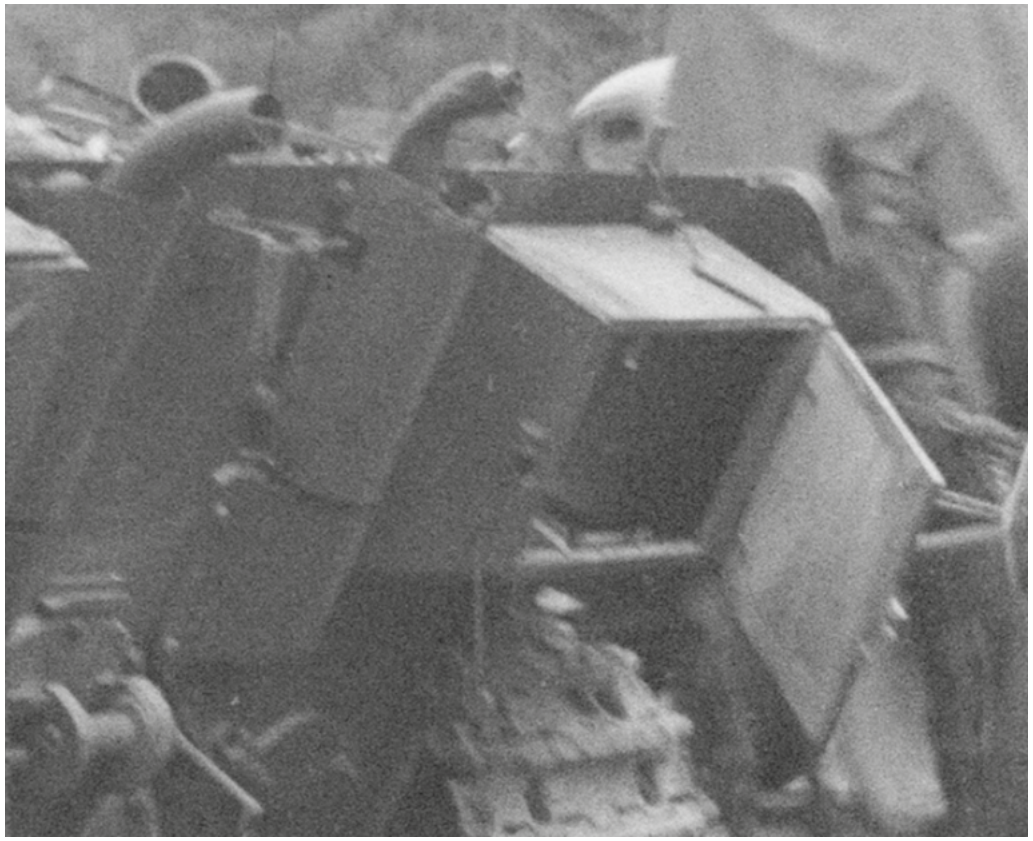


The location of the armoured stowage box fitted to the rear *Wanne* plate can help identify which assembly firm completed a particular Panther. ① Both Daimler-Benz and M.N.H. would mount the box so that its lower edge aligned with the bottom of the sponson. ②The I.R. prepared Panthers completed by M·A·N have this armoured box mounted so that its upper edge is aligned with the engine deck. ③ The armour plate door was secured using a handle on a threaded and hinged bolt assembly mounted on the side of the box. ④ A hasp for a padlock was welded to the door along with a steel plate that engaged with the threaded handle assembly. ⑤A lifting eye was welded to the top of the box which was both heavy and cumbersome.



Above:
There were numerous Panthers that had components fitted that were intended for use with I.R. equipment that were issued to the troops as orders to complete vehicles with these components fitted were issued and subsequently rescinded after vehicles had left the assembly plants. The armoured stowage box on the rear of this Daimler-Benz assembled Panther has been mounted so that the bottom plate is at the same height as the sponson floor. There are very few photographs that show the interior of the armoured box however some of the internal bracketry can be made out in this photograph. There is no evidence of any shock absorbing material whatsoever and it is likely that the bracketry alone was designed to insulate the contents of this box rather than any foam rubber or similar material. (BGAKFFD via Lee Archer)

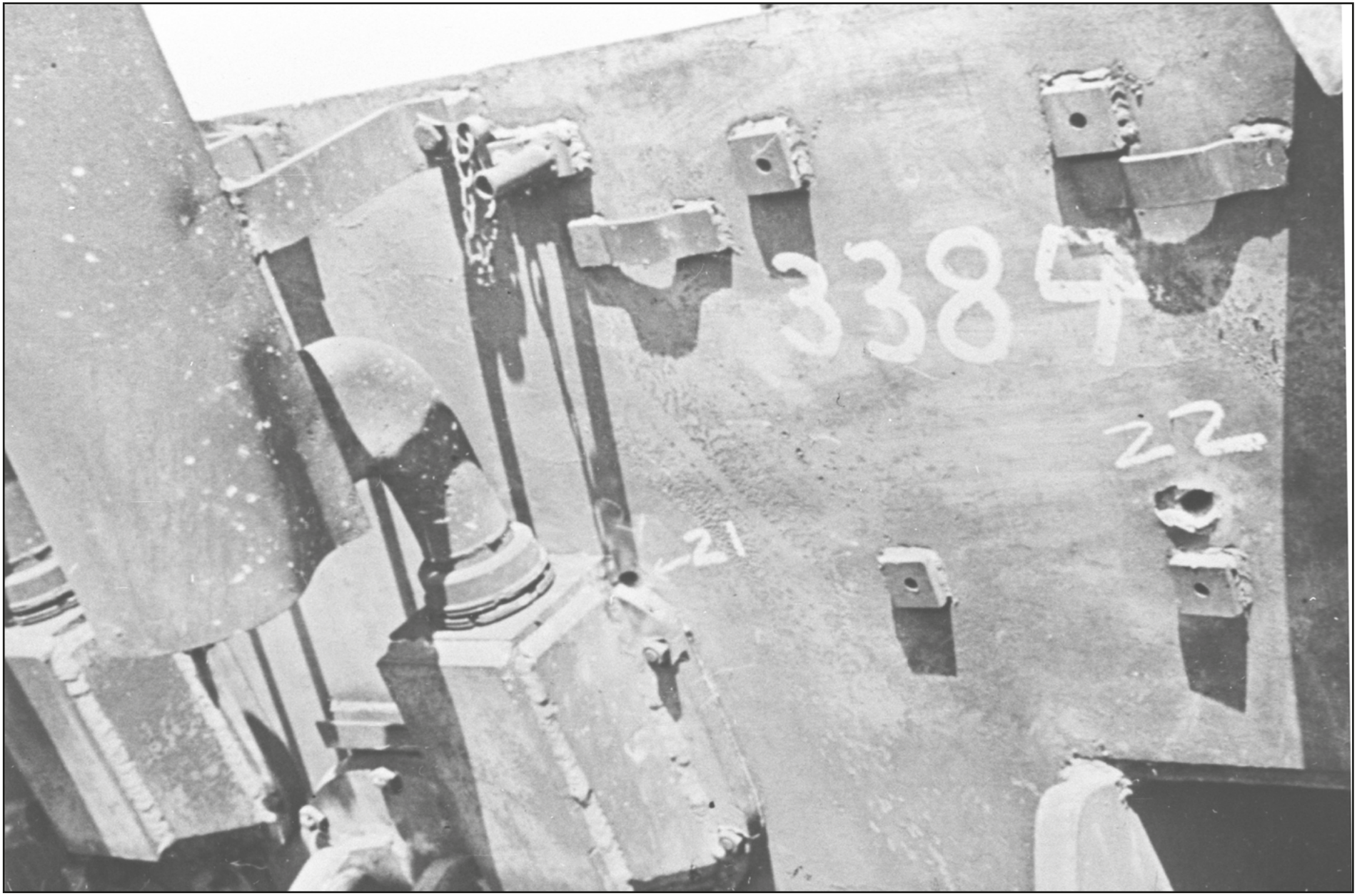
was photographed following its loss in the vicinity of Warka, south of Warsaw. Daimler-Benz did not install debris guards until after its official introduction in August. Panther *Fgst.Nr.* 124589 completed by Daimler-Benz on or around 23rd July 1944 and subsequently issued to I./Pz.Lehr-Rgt. 130 on 25th August was one of several Panthers issued to this unit assembled by Daimler-Benz in July that did not have a debris guard fitted but did have *Pilze* sockets for the 2ton *Behelfskran*. Daimler-Benz completed a number of I.R. prepared Panthers in July which were also issued to I./Pz.Lehr-Rgt. 130 attached to Pz.Brig.113 (see page 128). These vehicles were photographed during a parade held to mark the activation of the unit; these Panthers had been assembled with *Pilze* sockets but without a debris guard, they were initially delivered in an overall coat of *Dunkelgelb* RAL 7028. They were later repainted in camouflage schemes by the vehicle's crew or more likely the unit *Werkstatt* using the dilutable *Rotbraun* RAL 8017 (red brown) and *Olivgrün* RAL 6003 (dark olive green) camouflage paste issued with the vehicle to suit local conditions who then applied *Balkenkreuze* to the *Turm* sides for the activation parade. At least one of the I.R. prepared vehicles completed by Daimler-Benz and issued to I./Pz.Lehr-Rgt. 130 was equipped with an intermediate pattern strengthened gun mantle.

It was in late June or early July that the intermediate strengthened gun mantle was fitted by M.N.H. on some of the last *Ausführung* A Panthers it assembled. This part continued to be fitted to a small percentage of *Ausführung* G Panthers assembled by both M·A·N and M.N.H. up to the end of October 1944.

Wanne incorporating a curved opening in the glacis plate for the driver's periscope were introduced by the armour manufacturers, the delay between these being delivered to the assembly plants and their completion resulted in *Wannen* with this feature not appearing in significant numbers on completed Panthers until early September. The older square cut opening had disappeared from newly assembled Panthers by October. The sheet metal braces that connected the exhaust stacks and jack stowage bracket were discontinued by M·A·N in June and Daimler-Benz in July, M.N.H. would continue to install these until the end of August 1944.

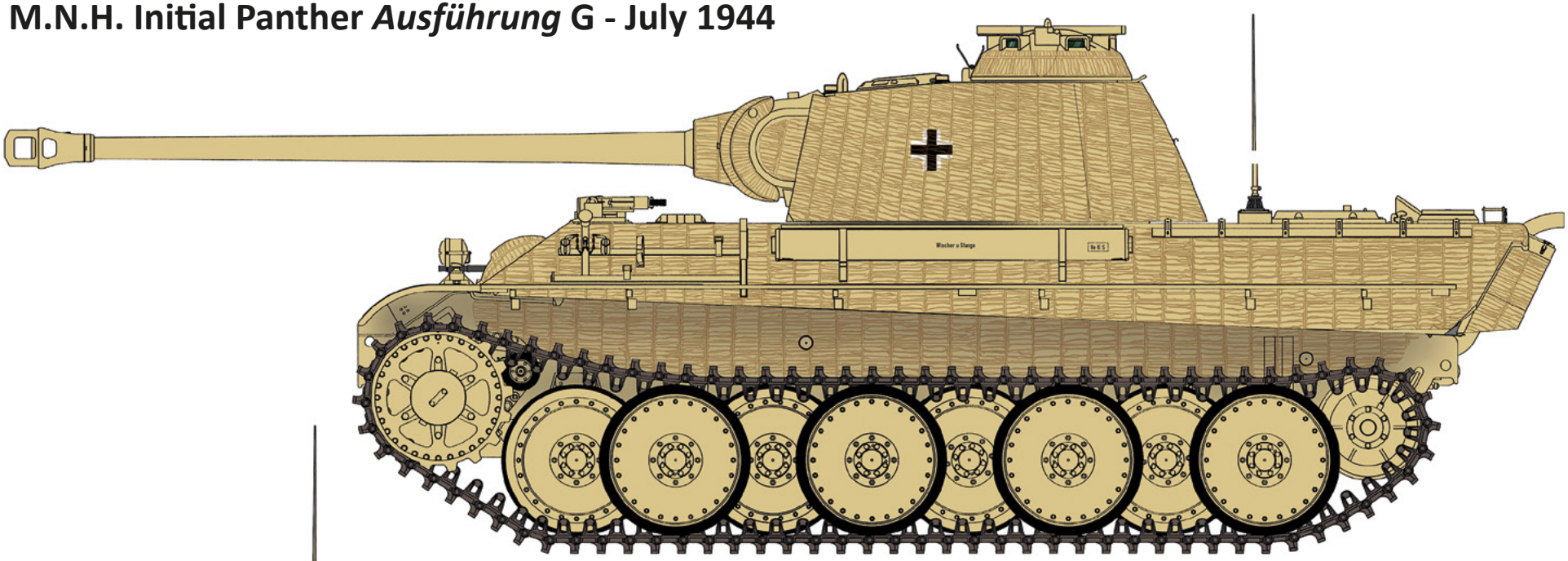
M.N.H. would be the last assembly firm switch over to assembly of the Panther Ausführung G series in early July 1944. They would incorporate all of the modifications officially approved up to that point on the vehicles they assembled. They adopted a different method for texturing the *Zimmerit* anti magnetic paste applied to the vertical armour surfaces that could be reached by a soldier with a magnetic mine. The pattern had a very distinctive ridged profile similar to the teeth of a saw. This was made with a spatula tool similar to a plasterer's trowel or float. The ridges on the glacis are interesting in that the tradesmen responsible for applying the *Zimmerit* worked in opposite directions from the centre of the glacis with a transverse transition line

This Pz.Bef.Wg. Panther from I./Pz.Lehr-Rgt.130 was completed by M·A·N in November or very early December 1944. It has been partially prepared for I.R. use, the mounting points for the armoured stowage box (which is missing) on the *Fahrgestell* rear plate are worthy of note. All the I.R. prepared Panthers assembled M·A·N had this armoured box mounted so that the top of the box was aligned with the engine deck. Both Daimler-Benz and M.N.H. would mount the box lower down with the bottom edge aligned with the sponson floor as per the plates on pages 207 and 237. (NARA via Steve Zaloga)



This Panther *Ausführung* G was one of nine that were found almost complete on the assembly lines at the M.N.H. plant in Hanover at the end of the war that were subsequently completed by former employees of the plant at the behest of British forces. It has mounting points for fitting the armoured stowage box associated with Panthers that have been partially prepared for use with I.R. equipment welded to the rear plate. A comparison of the height of these mounting points between the *Pz.Bef. Wg* Panther on the previous page and the M.N.H. Panther above reveal that they are noticeably lower on the M.N.H. vehicle. Panthers completed with this armoured stowage box by Daimler-Benz and M.N.H. all have the armoured stowage box mounted so that the bottom of the box is aligned with the sponson floor. (Tank Museum Bovington 6699-B6)

M.N.H. Initial Panther *Ausführung* G - July 1944



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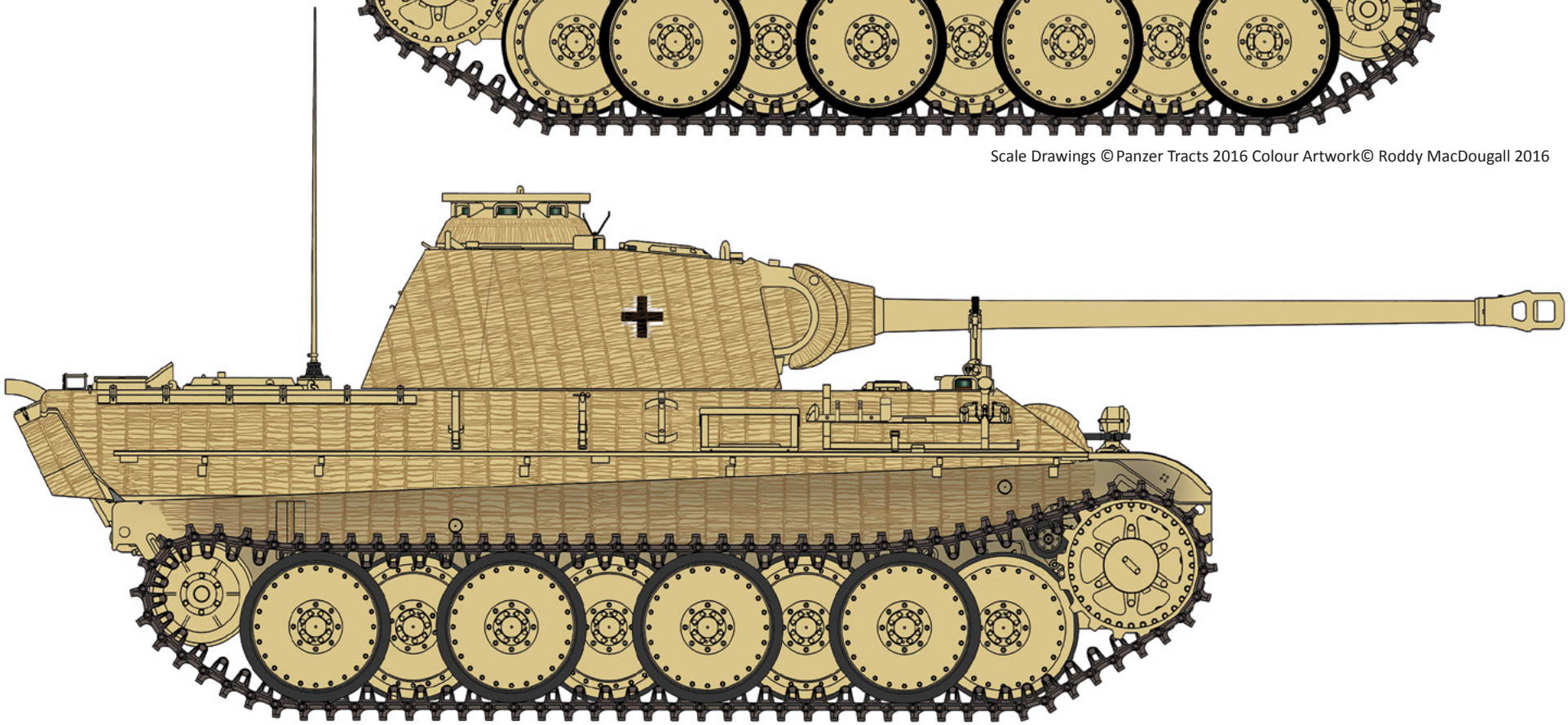

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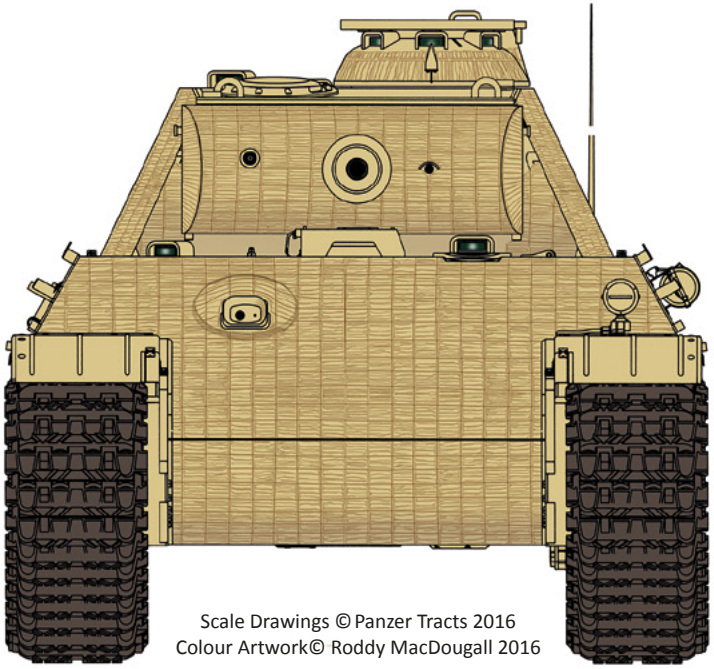

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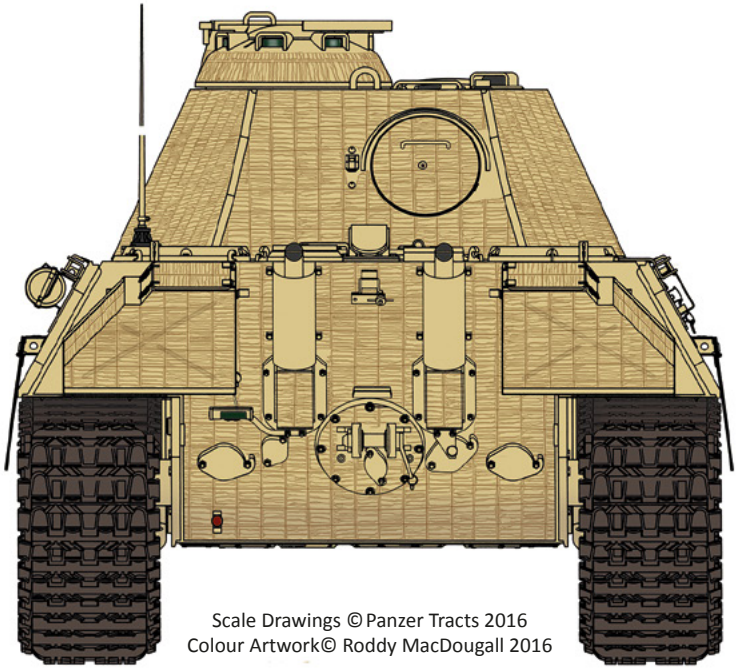

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Colour Artwork© Roddy MacDougall 2016

In July 1944 M.N.H. switched over to assembling the Panther *Ausführung* G incorporating all of the modifications officially approved up to that point on the vehicles they assembled. They adopted a different method for texturing the *Zimmerit* anti magnetic paste applied to the vertical armour surfaces that could be reached by a soldier with a magnetic mine. The pattern had a very distinctive ridged profile similar to the teeth of a saw. This was made with a spatula tool similar to a plasterer's trowel or float. The ridges on the glacis are interesting in that the tradesmen responsible for applying the *Zimmerit* worked in opposite directions from the centre of the glacis with a transverse transition line around the height of the top of the fenders. All of Panther *Ausführung* G assembled by M.N.H. would also have *Zimmerit* applied to the commander's cupola until the application of *Zimmerit* was ordered to be discontinued completely. M.N.H. ceased applying *Zimmerit* to the fenders with the introduction of the Ausf. G; they had previously applied *Zimmerit* to the fenders on the Ausführung A Panthers they completed. M.N.H. assembled Panther *Ausführung* G also had the bracket for the track changing cable welded vertically to the *Fahrgestell* side until early August when both they and Daimler-Benz welded this part on to the *Fahrgestell* side horizontally. The initial vehicles delivered by M.N.H. were equipped with welded exhaust armoured guards. M.N.H. would be the first assembly plant to start completing Panthers with the new design of forged armoured exhaust elbow at the end of August. The majority of *Ausführung* G Panthers assembled by M.N.H. had *Balkenkreuze* applied to the *Türme* sides, no *Balkenkreuze* were applied to the *Fahrgestell*. A small number of *Ausführung* G Panthers assembled by M.N.H. had no national markings applied at all. The reason for this is not known but does not appear to have any correlation to when these Panthers were completed. The initial *Ausführung* G completed in July at M.N.H. were not fitted with a debris guard over the gun mantle, they would start to install this guard at the end of July or beginning of August.

around the height of the sponsons. All the assembly plants including M.N.H. applied a *Zimmerit* coating to the *Türme* prior to their being mounted on the *Fahrgestell*, there were a number of *Türme* completed which had been finished ahead of the introduction of this method of texturing the *Zimmerit* surface by M.N.H. that were mounted on *Fahrgestell* on which the new application method had been used. The Panther *Ausführung* G currently on display at Kubinka has the older pattern on the *Turm* and the new one on the *Fahrgestell*; it is the 3rd *Ausführung* G assembled by M.N.H. in July 1944 and has the *Fgst.Nr.* 128303[12]. All of the Panther *Ausführung* G assembled by M.N.H. would also have *Zimmerit* applied to the commander's cupola until the application of *Zimmerit* was ordered to be discontinued completely. M.N.H. ceased applying *Zimmerit* to the fenders with the introduction of the *Ausf*. G; they had previously applied *Zimmerit* to the fenders on the *Ausführung* A Panthers they completed. M.N.H. assembled Panther *Ausführung* G also had the bracket for the track changing cable welded vertically to the *Wanne* side until early August when both they and Daimler-Benz welded this part on to the *Wanne* side horizontally. The initial vehicles delivered by M.N.H. were equipped with welded exhaust armoured guards.

The initial *Ausführung* G completed in July at M.N.H. were not fitted with a debris guard over the gun mantle, they would start to install this guard at the end of July or beginning of August. The majority of *Ausführung* G Panthers assembled by M.N.H. had *Balkenkreuze* applied to the *Turm* sides, no *Balkenkreuze* were applied to the *Fahrgestell*.

A small number of *Ausführung* G Panthers assembled by M.N.H. had no national markings applied at all. The reason for this is not known but does not appear to have any correlation to when these Panthers were completed.

On 18th July 1944 *Wa. Prüf 6* issued instructions to the assembly firms that starting in August they should install a rain guard for the driver's periscope. It would appear that only M.N.H installed this item prior to September as the M·A·N assembled Panther *Fgst.Nr.* 121020 completed on or about 15th September and issued to I./Pz.Rgt. 24 does not have this feature nor does Panther *Fgst.Nr.* 124726 completed on or about 13th September by Daimler-Benz. Panther *Fgst.Nr.* 128427 assembled by M.N.H. in early August 1944 and issued to Pz.Abt.2107 does not have a rain guard fitted however, Panther tactical number 252 that was issued to I./Pz-Lehr.Rgt. 130 on 24th August does have a rain guard fitted (see pages 229 to 231). The Jettisonable hatches for driver and radio operator are officially approved for inclusion in series production in August. As we have seen though, this feature was already present on completed all *Ausführung* G Panthers from the start of series production.
The *Belüftungspilz* (Domed air intake cover, drawing 021 D 51102 U1) that regulated the flow of air and could be used to halt air flow through the ventilator on the *Wanne* roof was to be reinstalled, it was previously ordered to be discontinued. The cover was fitted underneath the armoured vent guard and is extremely difficult to make out in period photographs. M.N.H. reported to the *Heeres-Waffenamt* on the 17th July that it still had some stocks of this component left over from the *Ausführung* A and they would start to fit these from Panther *Ausführung* G *Fgst.Nr.* 128371 which was completed on or around 22nd July 1944.

A memo was sent to the M.N.H. assembly plant on 18th July regarding an amended design for the periscope prisms in the *Wanne* (drawing 51144 U11) and reminding them that the hinges for the driver and radio operator's grip handles were to be modified in accordance with revision PV-G 520. The memo went on to say that the stowage bracket (50296 U6) for the *Scherenfernrohr* S.F.14.Z.Gi. (scissors telescope) was no longer to be installed in the *Türme* of new Panthers starting with the first vehicle of the *Ausführung* G series *Fgst.Nr.* 128301.

M.N.H. were instructed to immediately modify the bracket for the ammunition stowage (021 D 48335-13) on the *Wanne* interior floor on 21st July. The change was necessary because the dimensions of the ammunition casings differed greatly.

The assembly plants were also instructed on 21st July to install a revised 'type D' steering and brake hydraulic oil reservoir (021 D 48371 U33) as soon as possible. The revised reservoirs had bulging channels at the end faces on the inside of the container. Experience by M·A·N revealed that containers without these channels tended to lose 6 litres of brake fluid every 100 km. M.N.H. reported that they had 69 'type D' containers in stock, with another 723 of the older 'type C' design that needed to be reworked to 'type D' specification. M.N.H. was ordered to install the 'type D' containers from the first vehicle of order 60 095, *Fgst.Nr.* 128421 (vehicle 1171) onwards. As a result of the amount of work involved modifying these containers, Abt.4111 was ordered to select several companies to help with the rebuilding process in order to secure a continuous supply of the reworked containers.

On 27th July the assembly plants were informed by the *Heeres-Waffenamt* that the internal hatches 021 C 51137 U3 and U4 must be altered immediately. Vehicles that already had these hatches installed were to be reworked according to this design change. This change had proved to be necessary because the hatches, when pushed against the fire wall, cut the cable for the thermometer that was mounted on the fire wall.

A request from the troops that the tubular handles on the driver and radio operator's hatches be extended to 300mm was rejected by the *Heeres-Waffenamt* on 30th July following a consultation with the design team at M·A·N as the longer handles would impede the hatches. These handles were part of a hinge assembly that had already been redesigned in April to conform to the preliminary drawing PV-G 520.

12 The important connection between the new M.N.H. zimmerit pattern and the Fahrgestell numbers of the Kubinka and Overloon Panthers was first made by ManusGallagher in 2009.

Panther *Fgst.Nr.* 120790 had tactical number 332 painted on its Turm sides when it was captured on 13th September 1944 from 3./Pz.Rgt. 29 who were serving as the Panther *Abteilung* for Pz.Brig.112 during the battle at Dompaire in the Lorraine region of Northern France. It was completed by M·A·N on or about 30th July 1944, it was fitted with a debris guard over the gun mantle and jettisonable hatches for the radio operator and driver (One of the hatches can be seen is lying in the forground on this photo). It was completed in an overall coat of *Dunkelgelb* RAL 7028 and would be issued along with tins of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 acrylic paste concentrate for the vehicle's unit *Werkstatt* or crews to apply camouflage locally. It does not have the "leopard spot" camouflage scheme. This Panther is currently on display at the Musée des Blindés at Saumur. (NARA via Darren Neely)

7. AUTUMN 1944 & FACTORY APPLIED CAMOUFLAGE

August 1944

The *Heeres-Waffenamt* sent an extensive list of parts and instructions to M.N.H. on 7th August regarding the forthcoming introduction of Panthers prepared for use with the FG 1250 I.R. night vision equipment that were scheduled to commence in September 1944. The communiqué also mentioned the introduction of the *Warmluftbeheizung* (warm air heater) that was also scheduled to be introduced to series production in September, however we will come back to this new component later. This communiqué is confusing as it appears to be related to a design change for the FG 1250 equipment that meant some of the current internal components for this equipment would need to be removed from a proportion of the vehicles as they would not work with the redesigned FG 1250. Space precludes us from providing a full transcript that includes a full component list from this communiqué however some important points are listed below:

- Scheduled Production Run: 50 vehicles in September 1944, 70 vehicles in October 1944, 80 vehicles in November 1944 and 100 vehicles in December 1944 to be equipped with the FG 1250.
- Because the production papers in our assembly plant for September and October have already been issued and a withdrawal or reworking of these would only result in a loss of time and a setback in production, we have made a proposal to the *OKH* to deliver 120 "G" vehicles in September 1944 with the warm air heater and 120 "G" vehicles in October with warm air heater and FG 1250."

A reminder was included to ensure that every vehicle equipped for use with the FG 1250 was marked with an "F" after the last digit of the *Fahrgestell* number.

The drawing numbers for the FG 1250 equipment all fell within the 27- 8801.001 *Gruppe*, the armoured stowage box mounted on the rear of the *Wanne* was assigned the drawing number 27- 8801.007 and the base for the I.R. lamp and the *Bildwander* receiver was assigned 27- 8801.010-1 (4) at this point and the weatherproof Bosch sockets were assigned the number 27- 8801.001-72. The assembly plants were instructed to make appropriate allowances in their purchasing for standard component parts that were displaced by the FG 1250 equipment. The following day on 8th August the *Heeres-Waffenamt* sent the following memo:

"We refer to our memo from 7th August and announce that the OKH does not allow a contraction of the 120 units with the FG 1250 in October this year due to the military situation. Therefore we have to deliver 70 vehicles of the Ausführung G production in September with the Warmluftbeheizung (warm air heater) and the last 50 vehicles in September with the Warmluftbeheizung and the FG 1250. Abt.729 will be asked to issue the supply lists with the corresponding number of parts necessary for the afore mentioned vehicles. Supply lists for the vehicles with the FG 1250 will be specially created. We emphasize that for September-October production, we have already given out supply lists for the 120 "G" vehicles with Warmluftbeheizung and that supply lists for the 120 "G" vehicles with warm air heater and FG 1250 will be issued. Following the OKH's confirmation that the installation of the FG 1250 has to take place earlier then planned, it is ordered to install the sample FG 1250 in the 75th vehicle of order 60 095, Fgst.Nr. 128495 F (this was changed to Panther Fgst.Nr. 128557 on 14th September 1944)."

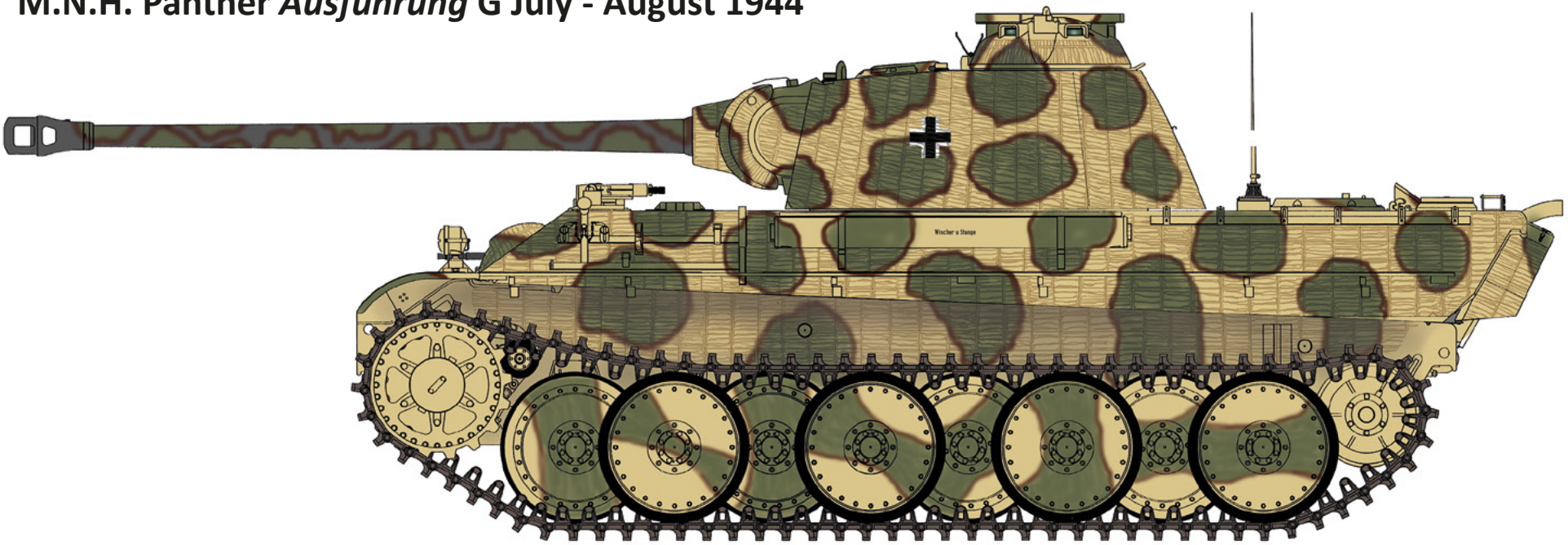
The debris guard fitted over gun mantle was officially introduced to production, as previously mentioned M·A·N had already started fitting this guard in July. Panther *Fgst.Nr.* 120734 completed by M·A·N around 16th July 1944 and issued to I./Pz.Rgt. 27, Panther *Fgst.Nr.* 128427 issued to Pz.Abt.2107 and lost at Overloon has a debris guard but not M.N.H. Panther *Fgst.Nr.* 128303 currently on display at Kubinka.

At some point in August both M·A·N and M.N.H. started to complete a number of Panthers without *Pilze* sockets on the *Turm* roofs. The absence of this feature can only be seen on a small number of vehicles which encompasses amongst others some of those delivered to Pz.Abt.2105 between 7th and 21st August 1944. The Pz.Bef. Wg. Panther I02 from this unit was lost at Eynatten on 12th September 1944. Panther *Fgst.Nr.* 121020 completed by M·A·N around 15th September and then subsequently issued to I./Pz.Rgt. 24 on 26th or 27th September 1944, has a debris guard but no *Pilze* sockets on the *Turm* roof. The absence of *Pilze* sockets did not last long, these were absent on intermittent Panthers with some vehicles having *Pilze* sockets completed alongside those without. Panther *Fgst.Nr.* 120790 completed on or about 30th July has *Pilze* sockets while Panther *Fgst.Nr.* 121052 completed on or about 22nd September does not[1]. This latter vehicle is one of at least two of the Panthers fitted with *gummigefederte Stahllaufrollen* road wheels completed in September that did not have *Pilze* sockets fitted while others completed beforehand do. *Pilze* sockets were present on all Panthers completed by M·A·N and M.N.H. before the end of September. The omission of *Pilze* sockets welded to the *Türme* roofs appears to be limited to the *Türme* manufactured by Eisenwerke Oberdonau that were fitted to Panthers completed in August and September 1944.

The armour manufacturers were known to have continued to assemble components needed for a specific *Ausführung* after its cessation at one or more of the assembly plants when that design was still being completed by another assembly plant. An

1 Panther *Fgst.Nr.* 120790 was issued to I./Pz.Rgt. 29 who were attached to Pz.Brig.112 in Alsace/Lorraine in Northern France. Panther *Fgst.Nr.* 121052 was issued to I./SS-Pz.Rgt. 1 and was lost during the Ardennes Offensive.

M.N.H. Panther *Ausführung* G July - August 1944



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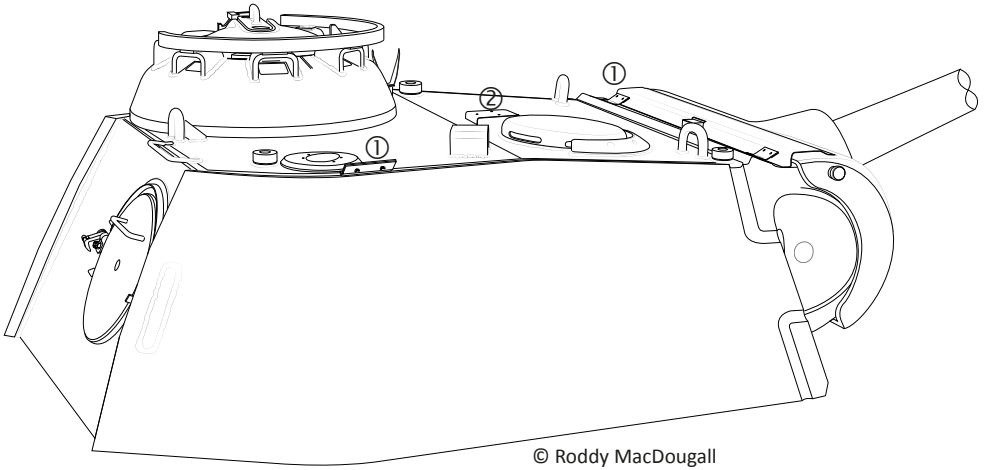
There is some evidence to suggest that there may have been a trial of a factory applied camouflage scheme conducted by M·A·N and M.N.H. prior to the order regarding factory applied camouflage schemes being issued on 19th August 1944. There are of photographs of the Panthers issued to Pz.Abt. 2105 between 7th and 21st August 1944 that show Panthers assembled by both of these assembly firms and subsequently issued to this unit painted in the same camouflage pattern. This "Leopard spot" scheme consisted of an overall coat of *Dunkelgelb* RAL 7028 that had fields of *Olivgrün* RAL 6003 that are completely encircled by a *Rotbraun* RAL 8017 border sprayed with diffuse edges. The *Balkenkreuze*, normally applied at the assembly plant, appear to be painted over the top of these schemes and in the case of the *Pz.Bef.Wg.* Panthers from this unit the tactical numbers have been applied over both the camouflage scheme and *Balkenkreuze*. Had these markings been applied by the crew or unit *Werkstatt* they would have ensured that these did not overlap or obscure each other thereby defeating the purpose of applying them. Pz.Abt. 2105 were also issued Panthers assembled by Daimler-Benz at the same time that do not have this camouflage scheme. Both M·A·N and M.N.H. plants would subsequently complete new Panthers in overall *Dunkelgelb* RAL 7028 in late August leading us to believe that this was a limited trial and it is not possible to determine with any certainty whether the scheme was applied at the assembly plant or by the units in accordance with guidelines or instructions they received. This scheme saw widespread use prior to its limited factory trial; it was applied by crews and units in the field on various types of vehicles including soft skins and *Panzerjäger*. The first use of this scheme on the Panther was the *Ausführung* G Panthers completed by M·A·N issued to 3./SS-Pz.Rgt. 12 seen transiting Paris on or about 24th June 1944 after being issued to the crews in early June. The factory applied markings have been covered which indicates that the camouflage has been applied after leaving the assembly plant. It is worth noting that there were also new *Ausführung* G Panthers completed by Daimler-Benz and at least one new Panther *Ausführung* A completed by M.N.H. in this column of vehicles that were finished in an overall coat of *Dunkelgelb* RAL 7028. The Panther depicted in the colour plate above was completed by M.N.H. in July or very early August 1944. The gun barrel was coated with a grey heat resistant lacquer at the manufacturers premises prior to being delivered to M.N.H. in Hannover and would not receive an overall coat of *Dunkelgelb* RAL 7028 prior to being camouflaged.

M·A·N and Daimler-Benz Ausf. G Turret September-December 1944

①*Lost Erkennungstafeln* (poison gas detector panels) and an ②*Orterkompass* mount were first fitted by M·A·N around the end of August, these new features would be introduced by the other assembly plants later in the year. Daimler-Benz would start to complete some Panthers fitted with an *Orterkompass* mount and *Lost Erkennungstafeln* around 19th September, though they would not fit these components to all of the Panthers they completed until the end of September.

M.N.H. Ausf. G Turret September-November 1944 ③M.N.H. would also start completing Panthers fitted with the Orterkompass mount at this point; it would be December before M.N.H. would complete any Panthers with Lost Erkennungstafeln fitted. ④In August a number of Panthers from all three assembly plants were completed that had a lug welded to the commander's hatch swing arm, this is very difficult to see in period photographs as it is quite small. The purpose of the lug is unknown, it does not appear to be a stopper designed to help halt the forward travel of the hatch prior to closing it as it does not engage with the main cupola casting or the steel plate stop welded to it. This lug would eventually be seen on almost all series production Panther by the end of November 1944.



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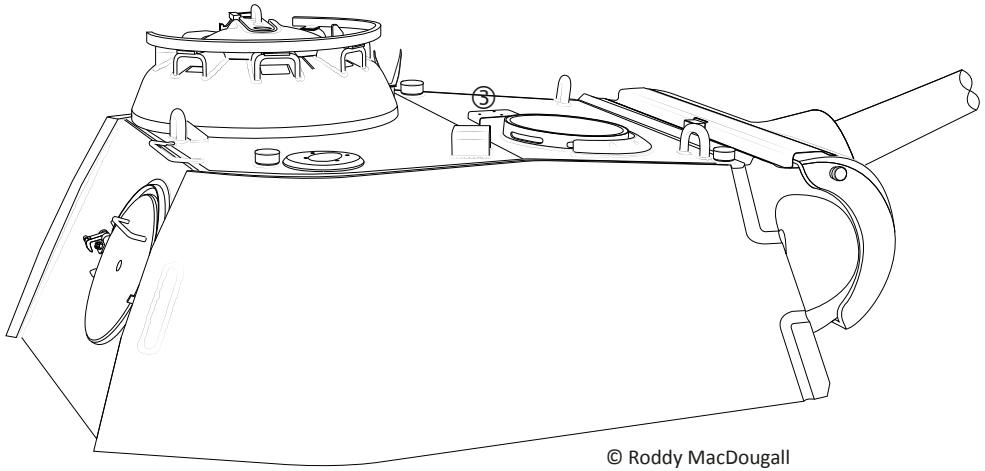

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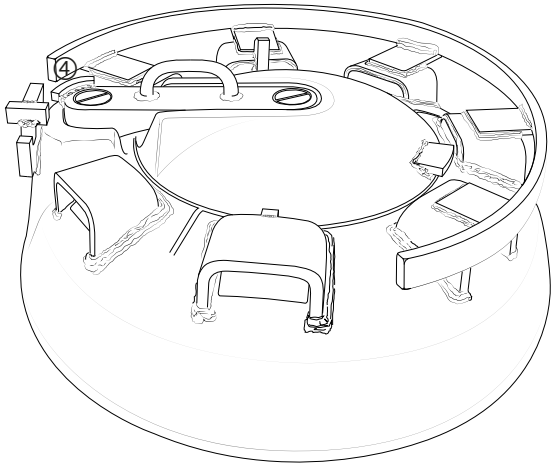

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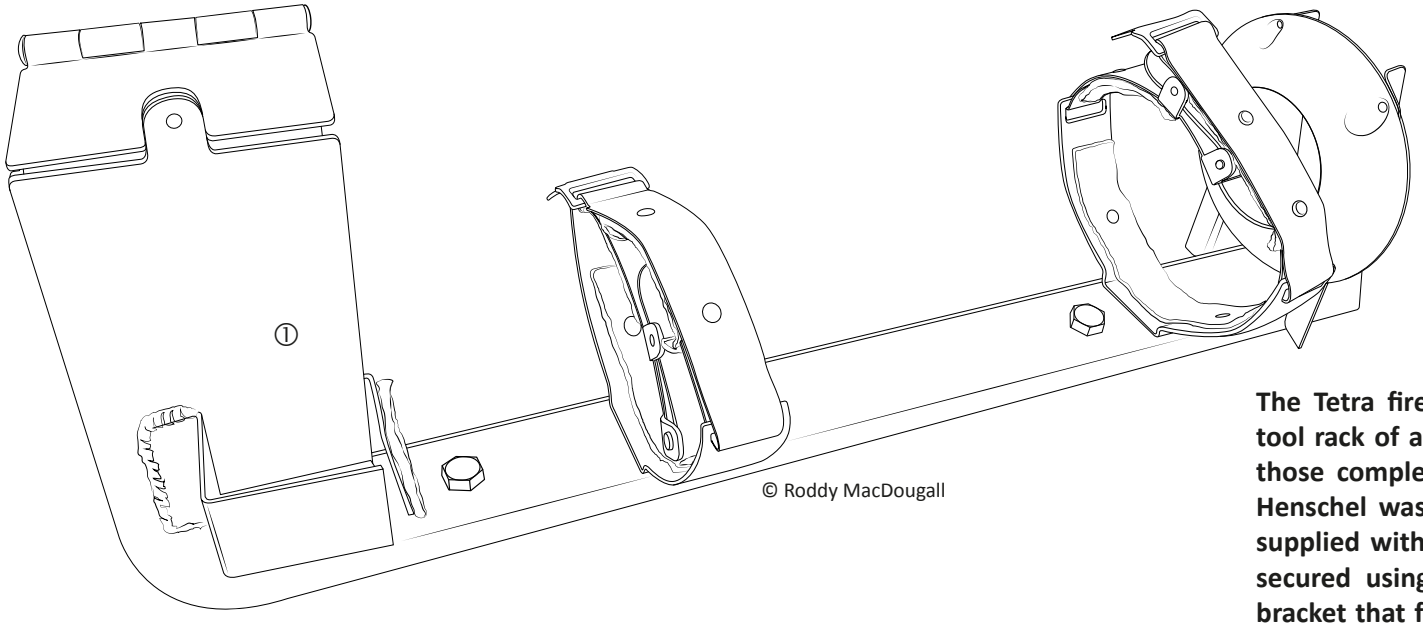
Tetra *Feuerlöscher* (Fire Extinguisher) Bracket



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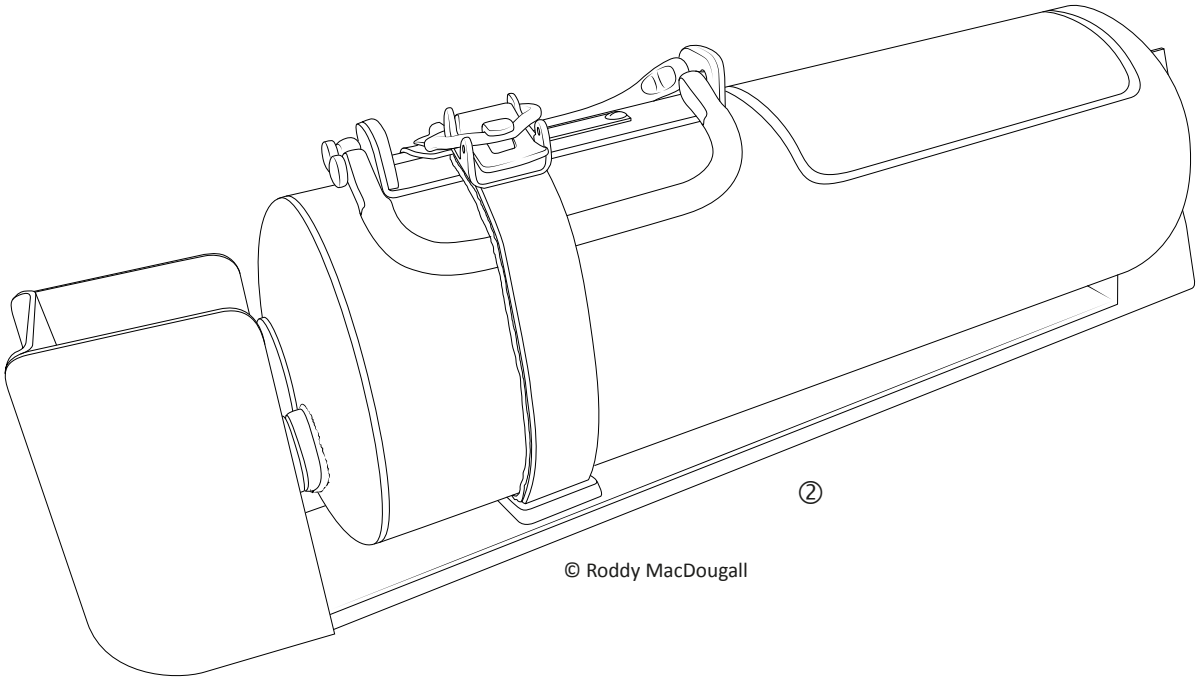

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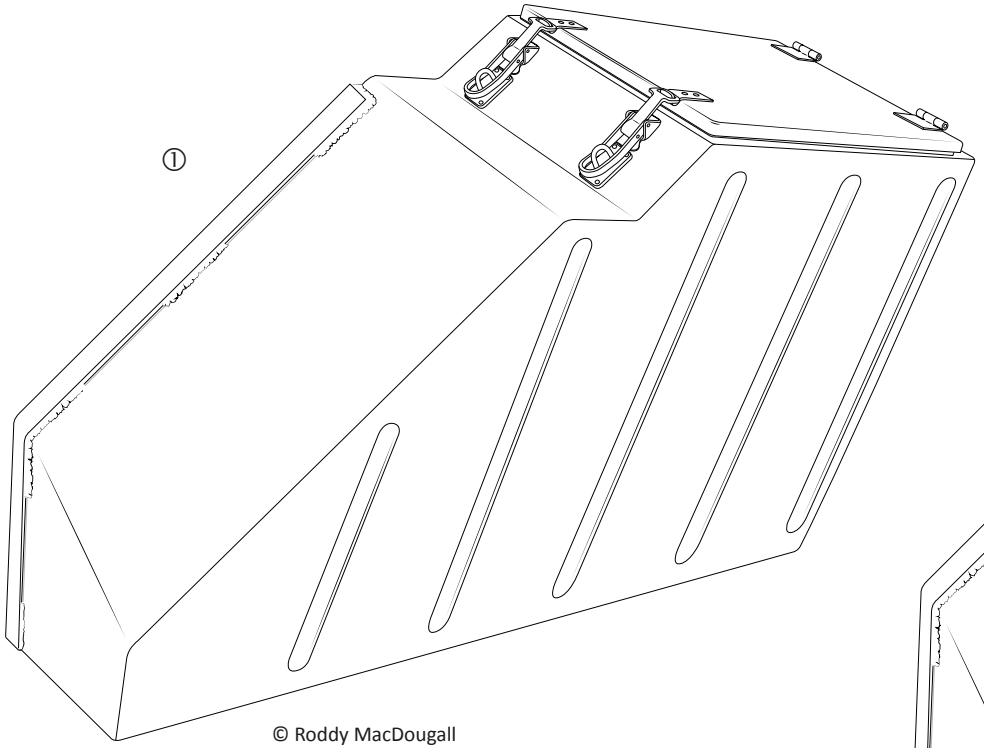
The Tetra fire extinguisher fitted to the starboard tool rack of all series production Panther excluding those completed between May and June 1943 by Henschel was mounted in a bracket designed and supplied with each extinguisher by Tetra. This was secured using 2 bolts in pre drilled holes in the bracket that fastened into two corresponding holes on the tool stowage rack. There were two different designs for the Tetra extinguisher bracket that can be categorised as the standard bracket which was used for most of the series production vehicles. ①This has an additional sheet metal box section welded to one side of the housing that protected the nozzle assembly. This additional box section provided a measure of protection for the charging port on the extinguisher. ②The late bracket was a simplified design that reduced the number of components and complexity of the frame, it can easily be identified by the single strap that secured the extinguisher to the bracket rather than the two straps used on the standard bracket. The bracket could be bolted on to the tool stowage rack with the nozzle assembly facing the front or rear of the vehicle, examples of both can be found in period photographs. The earliest Panther identified to date that was fitted with the late bracket was completed in late August 1944.



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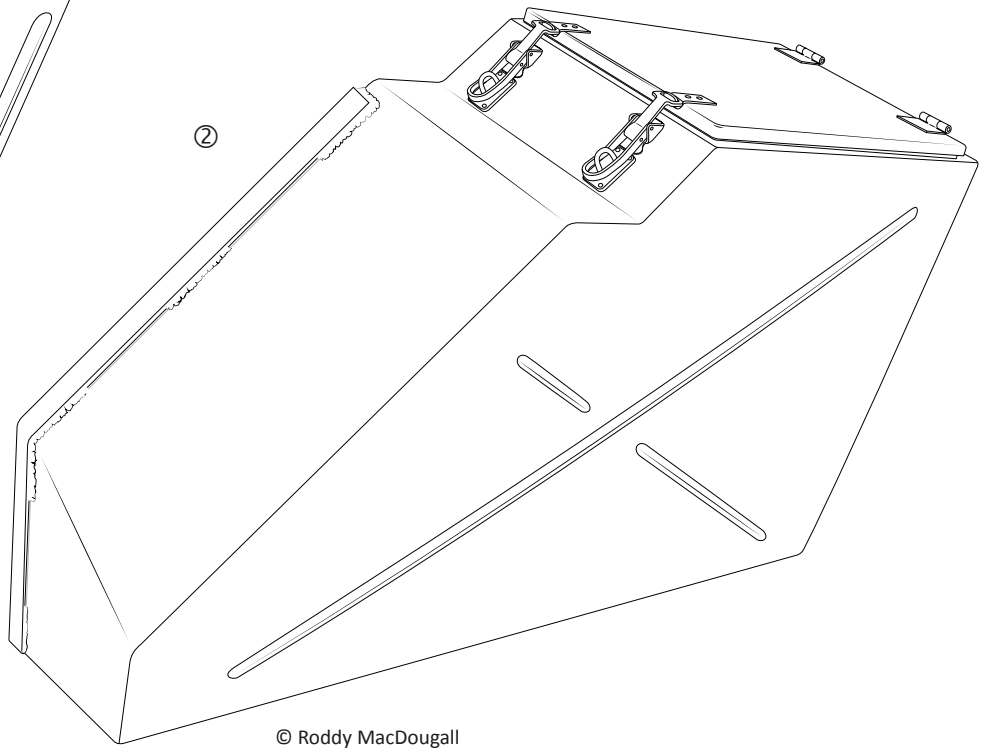

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Gepäckkasten (Rear Stowage Boxes)

Around the end of August or beginning of September, M.N.H. started to intermittently install *Gepäckkasten* with an ①alternative design of stamped reinforcing on some of the Panthers it completed. The stamped reinforcing ribs were arranged in vertical bars rather than the "X" shaped ribs ②used by all of the other assembly plants involved in Panther and Jagdpanther production. This alternative design appears on technical drawings for the *Ausführung* D dated February 1943 from M·A·N. This alternative design of *Gepäckkasten* was fitted to a small number of series production *Ausführung* G Panthers completed by M.N.H. between August and the end of the war.

Opposite Page:
An almost complete Panther at the end of its 50-60km test drive during the *Abnahmestelle* procedure at the M·A·N facilities at Hainberg in August 1944. The frames for the *Gepäckkasten* (rear stowage boxes) have been mounted on the brackets but the boxes themselves have still to be welded in place. The vehicle has still to receive its final coat of paint which at this stage of the war would probably include a factory applied camouflage scheme. The white rectangle outline on the cupola surrounds the number of this part so that it can easily be found by the *Heeres-Waffenamt* inspector as part of the *Abnahmestelle* inspection process. There are three *Wehrmacht* soldiers assisting, It was common practice for Panzer units to send crews to the factory to assist in the final stages of completion of their new Panthers. (Johann Buchner M·A·N)

example of this is the motor cover without the central tow coupling which Ruhrstahl Hattingen continued to manufacture in order for M.N.H. to complete vehicles prior to the finalised design of the new jack stowage brackets. As previously mentioned the *Ausführung* G was created by mounting the existing *Turm* design from the *Ausführung* A on to a new *Wanne* design, the *Turm* design remained unchanged but when *Pilze* sockets were introduced for the *Türme* it was not implemented on any of the *Ausführung* A still being completed by M.N.H. It is probable that the *Türme* without *Pilze* sockets were completed by the armour manufacturer Eisenwerke Oberdonau to the earlier specification used for *Ausführung* A and subsequently accepted by the *Heeres-Waffenamt* when installed on an *Ausführung* G.

M.N.H. started installing the new forged exhaust armoured elbows on completed vehicles towards the end of August, at least one of the vehicles fitted with this new part was issued to I./Pz.Rgt. 29 attached to Pz.Brig.112 on 3rd September and another to I./SS-Pz.Rgt. 9 on 19th September. Daimler-Benz started completing Panthers with this part at the end of September.

In August a number of Panthers were completed that had a lug welded to the commander's hatch swing arm, this is very difficult to see in period photographs as it is quite small. The purpose of the lug is unknown, it does not appear to be related to the planned introduction of I.R. equipped Panthers or a stopper designed to help halt the forward travel of the hatch prior to closing it as it does not engage with the main cupola casting or the steel plate stop welded to it. It can be seen on an M.N.H. assembled Panther *Ausführung* G lost during the autumn battles in Alsace/Lorraine and the Pz.Brig.105 Pz.Bef.Wg. Panther I02 lost at Eynatten. Daimler-Benz started to install cupola hatches with this lug in September; it became a standard feature on almost all of the Panthers assembled from October onwards. The assembly plants were informed on 25th August that *OKH Wa Prüf 6 Pz IIId* had ordered the use of *Lauchtfarbenanstrich* (fluorescent paint) in tanks and assault guns to be discontinued.

M·A·N would reverse the stowage brackets for the *Nachfriströhre* (Antenne extension rods) underneath the gun cleaning tools tube. The brackets were reversed to allow the rods to face the opposite direction with their clamps facing the front of the vehicle. When travelling through dense foliage this arrangement was less prone to the clamps working loose when the lever that fastened them was caught on branches. Around the same time in August 1944 the design of the two brackets used to mount the Nachfriströhre on the inner face of the starboard *Gepäckkasten* (rear stowage box) was changed so that this component was now fabricated as a single unit, this was a sturdier design and far easier to align correctly during the vehicles assembly. These brackets are very difficult to see on period photographs as they are often in the shadow caused by the reverse slope of the rear plate of the Wanne.

Factory Applied Camouflage

The first of the two most significant modifications that would affect the appearance of the Panther *Ausf.* G occurred in August 1944.

The colour scheme implemented in February 1943 had not changed so that Panther *Ausführung* G left the M.N.H. assembly plant in the same overall coat of *Dunkelgelb* RAL 7028 as had been used on the *Ausf*. A and D before that. The vehicles were still issued with the tins of *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 paste concentrate that was to be applied by the vehicles' crews or the unit *Werkstatt* to create camouflage patterns suitable for local conditions. These instructions regarding the appearance of armoured vehicles and camouflage were still in place as Daimler-Benz switched over production to the *Ausführung* G in May and M.N.H. in July 1944.

In an attempt to overcome the considerable air threat that was prevalent on all fronts, economise valuable resources, streamline production and provide vehicles to the German *Panzerwaffe* that were available for immediate combat, German armoured vehicles were to have effective, standardised camouflage paint scheme applied at the assembly plants. These camouflage schemes were developed by the *Heeres-Waffenamt* who would send out *Tarnbilder* (templates or patterns) for the particular schemes that the individual assembly plants were to implement. The General Order dated 19th August 1944 sent to all of the assembly plants involved in the Panther programme stated that "all Panthers were to be painted with a standardised camouflage pattern prior to being shipped from the assembly plants". There is some evidence to suggest that there may have been a trial of a factory applied camouflage scheme conducted by M·A·N and M.N.H. prior to this order being issued. There are photos of Panthers issued to Pz.Abt.2105 between 7th and 21st August 1944 that show Panthers assembled by both of these assembly firms and subsequently issued to this unit painted in the same camouflage pattern. This scheme consisted of an overall coat of *Dunkelgelb* RAL 7028 that had fields of *Olivgrün* RAL 6003 that are completely encircled by a *Rotbraun* RAL 8017 border sprayed with diffuse edges.

Opposite Page:
This close up of Panther *Fgst.Nr. 121020* shows the evenly ridged texture on the surface of the *Zimmerit* paste. This was achieved using a roller with corresponding ridges along its length that is unique to Panthers assembled by M·A·N. The section of *Zimmerit* with the *Balkenkreuz* national marking was removed by locals several days after this photograph was taken and is missing from photographs taken several weeks later. It was knocked out on Rue Haute on the northeast side of the River Ourthe running through Hotton. The camouflage finish has already started to fade noticeably and should be compared to that seen on the Panther on pages 148-149 which was also completed in early September 1944. (NARA via Darren Neely)

Panther tactical number 332 is one of the Panthers originally issued to I./Pz.Rgt. 24 in September 1944 that saw service with this unit around Aachen prior to being transferred to I./Pz.Rgt. 16 in November 1944. This is one of the Panthers completed in late August or early September after the discontinuation of the "Disc" camouflage scheme by M·A·N and painted in a new factory applied camouflage scheme applied using what we think was acrylic paste for the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 colour fields. It has the white flat topped "A" applied to the gun travel lock following its acceptance for service with the Wehrmacht by the *Heeres-Waffenamt Abnahmestelle* inspectors at the M·A·N assembly plant. It has a coat of *Zimmerit* paste on all of the vertical armour plate and sheet metal surfaces apart from the front

fenders. These were no longer given a coating of *Zimmerit* paste at the M·A·N plant from the end of August on. The front face of the gun travel lock on the majority of Panthers completed by M·A·N would receive a coating of *Zimmerit* from the middle of August on. The bolted plate in the *Fahrgestell* roof that enabled the Panther's transmission and final drives to be removed without the need to remove the *Turm* has been blown out by an internal explosion. This Panther was knocked out in the village doctor's garden just behind Rue Haute in Hotton. It would remain in Dr. Godenir's garden for some considerable time after the war had moved on. (2x Robert Demelenne via Jean-Michel Delvaux)

The factory applied *Balkenkreuze* were painted over the top of these schemes and in the case of the units
Pz.Bef.Wg. Panthers the tactical numbers have been applied over both the camouflage scheme and
Balkenkreuze. Had these markings been applied by the crew or unit *Werkstatt* they would have ensured that these did not overlap or obscure each other thereby defeating thee purpose of applying them. This unit was also issued Panthers assembled by Daimler-Benz at the same time that do not have this camouflage scheme. This scheme saw widespread use prior to its limited factory trial; it was applied by crews and units in the field on various types of vehicles including soft skins and *Panzerjäger*. The first use of this scheme on the Panther was the *Ausführung* G Panthers issued to 3./SS-Pz.Rgt. 12 seen transiting Paris on or about 24th June after being issued to the crews in early June. The factory applied markings have been covered indicating that the camouflage has been applied after leaving the assembly plant.

The development of standardised camouflage patterns saw factory applied camouflage schemes officially introduced on 19th August 1944. Instructions were issued to the assembly firms to apply the camouflage pattern at the assembly plant with *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 spray painted in patches over the *Dunkelgelb* RAL 7028 base coat. This order created the camouflage pattern which has become widely known as the "Ambush" or "*Licht und Schatten*" camouflage scheme. There are surviving instructions which state that templates for the new camouflage patterns would be issued by the *Heeres-Waffenamt*[2].

September 1944

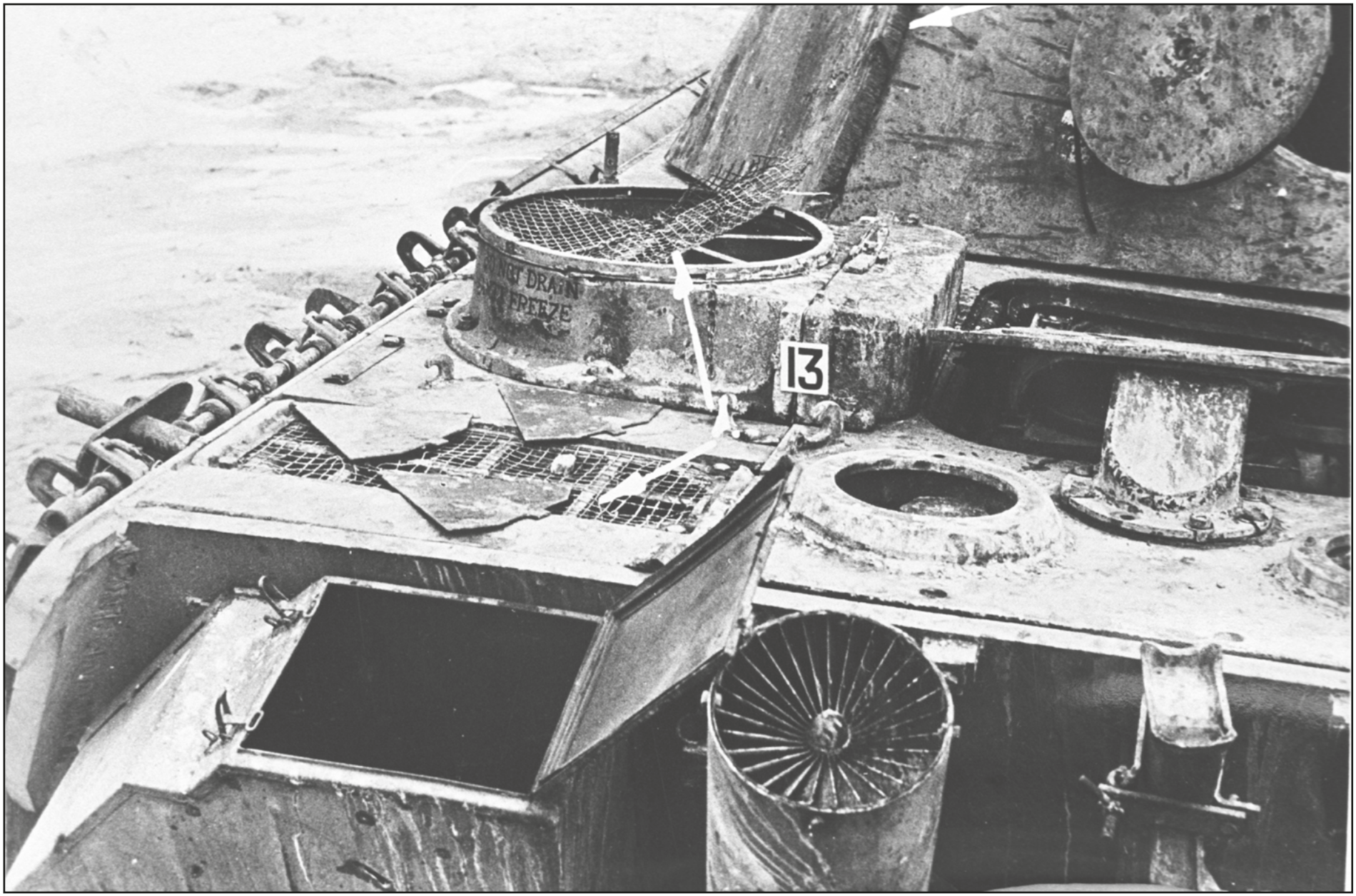
We can see how this order was implemented by both M·A·N and M.N.H. after the 19th August from the sequence of Panthers from Pz.Brig.111 photographed at Bures in the Lorraine region in September 1944, the vehicles issued to I./Pz.Rgt. 29 while it was attached to Pz.Brig.112 as well as the Panthers issued to I./SS-Pz.Rgt. 9 in September 1944. We can now see that larger areas of the Panthers are covered in green and red brown in comparison to the trial run batch. A prominent feature on these Panthers is the application of a "Disc" camouflage overlay in *Dunkelgelb* RAL 7028 which made up the "Ambush" element of this pattern. This was applied using a stencil mask made up with different sizes of discs connected together at the edges. There were typically 3 different sizes of discs used to create each stencil. The discs were arranged so that the left and right hand sides of the pattern could interlock which resulted in a repeating pattern that looked as though it had been applied with a roller or the repeating pattern on wallpaper. There were clearly instructions on how to create the stencils issued to the assembly firms, it is worth noting that there are several minor variations to the size and placement of the discs used to create the stencils so that subtle differences can be seen between different vehicles completed by either M.N.H. and M·A·N. The stencil was not always aligned on the vehicle during the painting process resulting in some of vehicles with this pattern leaving the assembly plant with overlapping or poorly aligned overlays. The mask itself was flexible enough to conform to the radius of the gun cleaning tools stowage tube and the sheet metal guards fitted over the exhaust stacks. There are no surviving examples of this mask so that we are left to speculate as to what material was used for these. This overlay was accompanied by meandering bands or areas of *Dunkelgelb* RAL 7028 applied with a spray gun randomly over the vehicle[3]. The 7.5cm Kw.K.42 L/70 main gun was delivered to the assembly plants in heat proof lacquer paint. This lacquer was either *Dunkelgelb* RAL 7028 or a dark grey colour; both Daimler-Benz and M.N.H. would apply any secondary camouflage directly to the dark grey lacquer of the guns finished in this colour. M·A·N would paint any grey lacquer barrels in an overall coat of *Dunkelgelb* prior to them being camouflaged during the application of the factory applied scheme.

We now have a very interesting anomaly, the 37 Panthers delivered to I./Pz.Rgt. 16 while it was attached to Pz.Brig.111 were all delivered between 3rd and 6th September 1944. These vehicles were extensively photographed in and around the village of Bures in the Lorraine region on 20th September where several of the Panthers completed by M·A·N can be seen to have "Disc" pattern factory applied camouflage. Unfortunately none of the *Fahrgestell* numbers on these Panthers are visible so we cannot confirm the date of their completion; however it has to be prior to 6th September at the latest and is almost certainly late August. The eight surviving Panthers would be handed over to I./Pz.Rgt. 15 from 11.Pz.Div on 28th September. The Panzer crews from I./Pz.Rgt. 16 would rejoin their parent unit 116.Pz.Div on 8th November at which point all of the Panthers from I./Pz.Rgt. 24, who were previously attached to 116.Pz.Div. were transferred to them. This confusing game of musical chairs is important because several of the Panthers transferred from I./Pz.Rgt. 24 that were delivered in September were completed by M·A·N with a camouflage scheme that is significantly different in appearance to either the "Disc" camouflage scheme used before they were built or the camouflage schemes used from 17th/18th September on.

We cannot determine with certainty if M·A·N completed these Panthers in an overall coat of *Dunkelgelb* RAL 7028 and were subsequently issued to their units with tins of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 acrylic paste concentrate to allow the units to camouflage them in accordance with guidelines or specific instruction. This does seem to be an extremely remote possibility but one that cannot be dismissed completely. It is more credible that these Panthers were completed in

2 There are several references to templates in instructions sent by the *Heeres-Waffenamt* to M.N.H. from Autumn 1944 on.

3 The early research and identification of this pattern was carried out by Manus Gallagher, this was first made available on the internet discussion group "Missing Lynx" and subsequently published as part of an article in *AFV Modeller Magazine #16* (May 2004).



The *Warmluftbeheizung* (warm air heater, drawing 51123) or, as it has since become known, the *Kampfraumheizung* (crew compartment heater) was introduced to series production in early September by M.N.H. The first Panther equipped with a *Warmluftbeheizung* (warm air heater) was the 17th vehicle from order 60 096 with Fgst.Nr. 128557 completed by M.N.H. on or around 11th September 1944. This new design feature would eventually be rolled out to all of the assembly plants invloved in the Panther programme shortly after this and it would become a standard component on all new Panthers. The Panther above is one of the REME assembled Panthers completed by former M.N.H personnel using original components in 1946. The vertically ribbed *Gepäckkasten* are unique to a small number of series production Panthers completed by M.N.H. This Panther was used as a target during gunnery trials where this photograph was taken to record the damage. (Tank Museum Bovington 6166-E1)

a new camouflage scheme applied at the M·A·N assembly plant using paint with significantly different characteristics to the paint used on the "Disc" camouflaged Panthers completed earlier. The *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 elements of this later scheme are either quickly absorbed into the *Zimmerit* paste or fade rapidly on the areas of the vehicle coated with *Zimmerit* but retain their colour fastness on the metal surfaces of the vehicle. It is possible that acrylic paste was used for these two colours rather than the urethane synthetic resin paints used for the "Disc" camouflage schemes which were more colour fast[4].There is some consistency in the size, location and appearance of the colour fields on these vehicles that can be seen on Panthers issued to different units that is an attribute of factory applied camouflage schemes. We cannot determine with certainty if M·A·N completed these Panthers in an overall coat of *Dunkelgelb* RAL 7028 and they were then subsequently issued to their units with tins of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 acrylic paste concentrate to allow the units to camouflage them in accordance with guidelines or specific instruction. This does seem to be an extremely remote possibility but one that cannot be dismissed completely. Two of these ex I./Pz.Rgt. 24 Panthers were knocked out in Hotton during the Ardennes Offensive, the *Fahrgestell* number of the vehicle knocked out on the Rue Haute (*Fgst.Nr.* 121020) is visible in several photographs and confirms that it was completed on or about 15th September 1944. Panthers completed in this manner and accepted by the *Heeres-Abnahmestelle* in early September were also issued to other units such as III./Fhr.Gren.Brig so that they are not limited to a single unit.For whatever reason M·A·N would either stop applying a factory applied camouflage scheme or use paints for a new scheme that have considerably different properties on the Panthers they completed for a period that is probably little more than two weeks between the end of August and the 16th/17th September 1944. M·A·N would recommence applying a factory applied camouflage scheme with more familiar characteristics no more than three days after Panther *Fgst.Nr.* 121020 was completed, Panther *Fgst.Nr.* 121032 was completed by M·A·N with a factory applied camouflage scheme on or about 18th September.

There is no evidence that Daimler-Benz applied any form of factory applied camouflage scheme during this period. There are several photographs of Daimler-Benz assembled Panthers issued to the troops during this time frame that show that vehicles from this assembly firm were delivered in the same overall coat of *Dunkelgelb* RAL 7028 as had been used since February 1943.

Lost Erkennungstafeln or poison gas detector panels and an *Orterkompass* mount were first fitted by M·A·N around the end of August or beginning of September[5], these new features would be introduced by Daimler-Benz a few weeks later and by M.N.H. in December. M·A·N also appear to have completed their first I.R. prepared Panthers at the end of August or beginning of September, the armoured stowage box for this equipment is mounted so that the top of the box is aligned with the upper edge of the rear plate and engine deck, this feature is unique to I.R. prepared Panthers completed by M·A·N.[6]

A sprung tab was added to the top section of the internal bolt mechanism for the *Turm* escape hatch on a small number of Panthers completed by M·A·N in September. This was designed to hold the bolt in the retracted unlocked position. The bolt had a tendency to extend to the locked position as a result of vibration and jarring as the vehicle was underway which then made contact with the aperture rim if the crew attempted to close the hatch without first retracting the bolt. The Panthers assembled by M·A·N that received a factory applied camouflage scheme are typically characterised by counter shading on the gun barrel. The *Dunkelgelb* RAL 7028 paint on the muzzle brake appears to have been masked during the application of the scheme.

Around the end of August or beginning of September, M.N.H. start to intermittently install *Gepäckkasten* with an alternative design of stamped reinforcing on some of the Panthers it completed. The stamped reinforcing ribs were arranged in vertical bars rather than the "X" shaped ribs used by all of the other assembly plants involved in Panther and Jagdpanther production. This alternative design appears on technical drawings for the *Ausf.* D dated February 1943 from M·A·N. The only known examples of any Panthers completed by this assembly firm with this design modification were the two Panther *Versuchsfahrgestelle* completed in late 1942[7]. This alternative design of *Gepäckkasten* has only been seen on series production Panthers completed by M.N.H. and can only very rarely be seen in period photographs[8].

The *Heeres-Waffenamt* informed the assembly firms on 4th September that there were some issues with the drawings for the *Getriebebelüftung* (transmission ventilation). It has been observed that duct 51164-45 leading to flange 51164-46 on drawing 51164 U8 was short by 40mm. This pushed the transmission ventilation duct against the gearbox drain valve. M.N.H. were ordered to modify these components starting from *Fgst.Nr.* 128557 completed on or around 11th September on.

Shortly after the introduction of factory applied standardised camouflage schemes M.N.H. started to complete Panthers fitted with a *Warmluftbeheizung* (warm air heater, drawing 51123) or as it has since become known *Kampfraumheizung*

4 Colour fastness is the media's, in this case paint's, resistance to fading, bleaching or running.

5 I./Pz.Rgt. 4 (later renamed I./Pz.Rgt. 26) was issued Panthers in September 1944 equipped with *Lost Erkennungstafeln* and finished in a full coat of *Zimmerit*. Some of these vehicles were lost in April 1945 around Sesto Imolese in combat with troops from New Zealand.

6 MacDougall and Neely: *Nürnberg's Panzer Factory.*

7 Jentz and Doyle: *Panzer-Tracts No.5-1 Panzerkampfwagen Panther Ausführung D.*

8 One well known vehicle equipped with the alternative design of *Gepäckkasten* was the Panther "Cuckoo" that originally belonged to Pz.Abt.2107 from Pz.Brig.107. The tank was captured in a barn in the Dutch village of Overloon in October by men of the 4th Battalion Coldstream Guards, part of the British 6th Guards Tank Brigade.

M·A·N would complete their first *Infra Rot* or I.R. prepared Panther in early September 1944. The Turm roof was fitted with *Lost Erkennungstafeln* as well as Pilze sockets for a 2ton *Behelfskran*, a small crane that could be mounted on the Turm to assist in removing some of the heavier components. This photograph was taken to record the detail on the I.R. lamp mounting plate fitted to substantial rectangular steel plates welded permanently to the Panther's gun mantle. The plate was held in place by four 30mm bolts and had a weatherproof socket that would be powered via a lead from the *Turm*. The mounting point for the I.R. lamp has the four pin Bosch electrical connection as used for the Bosch headlamp in this specially made plate (drawing 8801.001.72). The vehicle was given a coat of *Zimmerit* and it is probable that it was finished in a factory applied camouflage scheme given its date of manufacture along with the technical objective of the photograph. The stowage bracket for the Tetra fire extinguisher is the later pattern with a single set of metal fastening straps. The silhouette in the camouflage paint indicates the extinguisher was fitted in the bracket when the camouflage pattern was applied. (Johann Buchner M·A·N)

Panther Fgst.Nr. 121047 was completed by M·A·N on or around 21st September with *gummigefederte Stahllaufrollen* that significantly reduced the amount of rubber used to cushion the wheel. M·A·N would start to fit Warmluftbeheizung (crew compartment heater) on the test series of Panthers fitted with *gummigefederte Stahllaufrollen.* The centre plate that protected the hub assembly on the outer row of interleaved road wheels on the port side are missing. The barrel of the 7.5cm Kw.K.42 L/70 main gun was cut by U.S. forces shortly after they had retaken the area, this was done to ensure the vehicle could not easily be returned to service in the event of a counterattack by German forces. Panther *Fgst.Nr.* 121047 was issued to 2./SS-Pz.Rgt. 1 (*Ustuf.* Hubert Kaufmann) and given the tactical number 212 on the port side before this was

corrected to 211 to match the number on the rear and starboard *Turm* sides. It was camouflaged at M·A·N using urethane resin *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 paints. The 600mm diameter *Leitrad* (idler wheel) on the port side has been badly damaged during an exchange of fire with U.S. forces just west of Stoumont railway station where this vehicle was knocked it. It is seen on the previous page being examined by officers and men accompanying Lt Col Burton Ellis from the U.S. JAG in 1946. (Ellis collection via Darren Neely and CRIBA via Eddy Monfort).

(crew compartment heater) in early September. The *Heeres-Waffenamt* had sent a memo to M.N.H. who would lead the introduction of this new set of components on 19th August regarding plugging apertures in the engine partition wall (51101-23) and indicating which holes needed to be welded closed on drawing TuB 21 27. A number of new holes would also need to be drilled until *Wannen* that had already been modified were delivered to the assembly firms by the armour manufacturers. A further memo was sent on 4th September regarding the duct pieces 51123 U22 and U23 that carried the warm air into the vehicle's fighting compartment not being secured in place with clamp 51123-126. The clamp was too small, while at the same time it was supposed to secure the duct bend 51123 U16 on the floor. A wider clamp PV-G 526 had been designed to connect the duct pieces that the assembly firms were to manufacture themselves. This was to be fitted to the first Panther equipped with a *Warmluftbeheizung* (warm air heater) onwards, this was the 17th vehicle from order 60 096 with *Fgst.Nr.* 128557 completed by M.N.H. on or around 11th September 1944.

One of the first Panthers fitted with this design modification was issued to I./SS-Pz. Rgt. 9 who lost the vehicle in Elst, Holland on 23rd September 1944. Other assembly plants would start to install this equipment in mid September. Daimler-Benz had supplies of the redesigned engine decks delivered from the armour manufacturers with relocated lifting hooks and the apertures for the warm air ducts associated with this
Warmluftbeheizung but had no fan tower castings. The apertures were covered with a steel plate held in place by two bolts through the mounting holes for the armoured duct casting. The standard fan tower casting was used until supplies of the new part became available to them in late September.

The *Heeres-Waffenamt* informed the assembly firms on 6th September that following instructions from the *OKH*, tracks sets would be delivered without spare links. The tracks were previously delivered with 86 links, will now receive 87 links during the deliveries from 1st August onwards. The 87th link was removed after the tracks were run in. This would take place from *Fgst.Nr.* 128551 completed on 9th September 1944 onwards, following which no more vehicles will be delivered with spare links. This did not mean that the vehicles would not be equipped with the 12 spare track links carried on the *Fahrgestell* sides, these would be issued along with the vehicles at the *Heereszeugämter*.

What is probably the most significant change that affected the appearance of the Panther *Ausführung* G was the order issued by *Wa.Prüf 6* to the assembly plants to discontinue the application of *Zimmerit* anti magnetic paste on 9th September 1944. There are several possible reasons for the discontinuation of this distinctive coating amongst which was that it was rumoured to be the source of vehicle fires following shell strikes on the armour. Tests were indeed conducted to determine the veracity of this rumour; however these were not conducted until November 1944[9]. This gives considerable weight to the probability that there were other factors influencing the decision to discontinue the application of *Zimmerit* paste. Whatever the reason, the *Generalinspektür der Panzertruppen* decided to order its discontinuation at a meeting on 7th September 1944.

As a result of the assembly plants coating major components with *Zimmerit* prior to final assembly a number of *Türme* that had already been given a full or partial coat of *Zimmerit* when the instruction to discontinue its application was received. As *Fahrgestell* that were bereft of *Zimmerit* proceeded through production the *Türme* that had previously been coated during assembly as a sub component were fitted to these *Fahrgestell* so that we can see a number of vehicles from both M·A·N and Daimler-Benz with bare *Fahrgestell* but a coating of *Zimmerit* on the *Turm*. Most of these vehicles were completed with a *Zimmerit* coating on the *Turm* shell but uncoated *Turm* escape hatch and or gun mantle. The use of *Türme* with a full or partial coat of *Zimmerit* has led to some erroneous speculation suggesting that these were vehicles assembled using recycled parts from damaged Panthers. M.N.H. received the order to discontinue the application of *Zimmerit* paste on 9th September and would seek clarification from the *Heeres-Waffenamt* regarding what to do with vehicles that were in the process of having a coating of *Zimmerit* applied when the instruction to cease its application was received. They were instructed by the *Heeres-Waffenamt* to continue and complete these vehicles as normal. A list of the last vehicles to receive this coating was supplied to the *Heeres-Waffenamt* by M.N.H. on 19th September 1944 which read:

"We have the following vehicles in the process of assembly that have received a protective coating:
128562 to 128565, 128568 to 128569, 128572 to 128579, 128581, 128583 to 128593 and from 128595 continuously would be completed without Zimmerit."

Daimler-Benz would finally adopt a standardised factory applied camouflage scheme shortly before the instruction to discontinue the application of *Zimmerit* paste was received. Prior to this all of the Panthers delivered by Daimler-Benz from February 1943 on were delivered in an overall coat of *Dunkelgelb* RAL 7028 and were still issued with the tins of *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 paste concentrate that was to be applied by the vehicles' crews or the unit *Werkstatt* to create camouflage patterns suitable for local conditions. Following the introduction of standardised camouflage schemes, Daimler-Benz would also fit spare tracks finished in camouflage colours to compliment the new standardised camouflage scheme to the vehicles it assembled up to the end of September / beginning of October.

We will call the camouflage scheme introduced by Daimler-Benz the "Classic" factory pattern as the basic pattern was used by Daimler-Benz from September 1944 to the last weeks of the war with only one minor change and it would also be introduced by M·A·N for a period of time but we will come back to this later. Large areas of the vehicle were now covered with clearly defined areas of *Rotbraun* and *Olivgrün* that

9 The tests conducted to determine the flammability of Zimmerit will be discussed in further detail on page 164

were sprayed on with great care. The colour fields had very tightly sprayed edges with minimal over spray, the tightly sprayed edges achieved as a result of this is a defining characteristic of Panthers assembled by Daimler-Benz. The edges of these fields were so carefully applied that they almost have the appearance of having sharp edges in some period photographs. The camouflage scheme applied by Daimler-Benz to the Panthers they assembled was never completed with a true hard edge applied with a brush, roller[10] or masks.

As previously mentioned there is evidence to suggest that a master pattern was used to define the placement size and shape of each of the colour fields. Although there are no known surviving templates for the Panther, drawings for other vehicle types as well as aircraft have survived. However there are surviving instructions from the *Heeres-Waffenamt* to the assembly plants where *Tarnbilder* are mentioned specifically as well as templates. The fact that the size shape and placement of the colour fields of the factory applied camouflage pattern on the Tiger II *Ausführung* B's assembled at Henschel in Kassel is almost identical to the "Classic" factory pattern used by both Daimler-Benz and M·A·N along with the consistency of its application can not be a coincidence[11]. There is also some anecdotal evidence to support this from a former Daimler-Benz employee who states that there was a pattern fixed to the wall that employees were to follow. This pattern has certain prominent characteristics that are immediately apparent in period photographs; the glacis has a small patch of *Dunkelgelb* to the top starboard side of the *Kugelblende* MG ball mount. There is also a stripe of *Dunkelgelb* starting from around the driver's periscope meandering its way diagonally down towards the bottom starboard corner of the glacis before continuing down to the lower glacis plate and then making for the lower port corner. On the gun mantle there is a dark yellow band coming down from the *Turm* roof to the starboard side of the gun tube aperture. The *Turm* has a large area of *Dunkelgelb* running diagonally from the lower interlocks back up to the midpoint of the *Turm* side.

The "Ambush" element that Daimler-Benz initially applied was an overlay consisting of small spots of camouflage paint applied to the larger colour fields of the main "Classic" camouflage pattern. This was not a haphazard application as depicted in numerous contemporary colour profiles but was carefully applied using only two colours. The contrasting overlay to the main *Olivgrün* and *Rotbraun* fields consisted of *Dunkelgelb* RAL 7028 spots. The camouflage overlay spots applied to the main *Dunkelgelb* RAL 7028 fields consisted only of *Rotbraun* RAL 8017. Panther *Fgst. Nr.* 124726[12] completed by Daimler-Benz on or about 13th September did not have a coating of *Zimmerit* and had the new standardised factory applied camouflage scheme complete with contrasting spot overlay. It should be noted that a common thread recurring in period documentation that was one of the major factors behind the introduction of factory applied camouflage schemes was the air threat. This was considered serious enough that specific instructions forbidding the movement by rail of large pieces of equipment painted in *Dunkelgelb* was sent to all of the assembly plants involved in the manufacture of armoured vehicles later in the year. With the introduction of factory applied camouflage schemes the *Schürzen* were painted in a camouflage scheme that would blend with that of the vehicles they were fitted to, it is probable that this was done with the plates mounted in a jig that would allow the painters to apply the camouflage in a similar manner to the camouflage on the vehicle. Photographic evidence confirms that they were not matched to each vehicle; these were then issued in sets with the Panthers. The method of painting the *Schürzen* would remain the same to the end of the war.

The discontinuation of *Zimmerit* also heralded the implementation of a change to the camouflage schemes applied to Panthers assembled by M·A·N. Instructions regarding the application of camouflage paint were issued to the assembly plants. This called for RAL 8017 *Rotbraun*, RAL 6003 *Olivgrün* and RAL 7028 *Dunkelgelb* to be applied sparingly over the top of red oxide primer. There is some debate as to exactly what was meant by this instruction; however we will examine how this order was interpreted and applied in practice by the three assembly plants.

As we have seen, the "Disc" pattern camouflage scheme was discontinued in August a month before the discontinuation of *Zimmerit* at M·A·N. When M·A·N reintroduced factory applied camouflage schemes with recognizable characteristics, the vehicles initially started of with an overall coat of *Dunkelgelb* RAL 7028, this is apparent when looking at period photographs of damaged vehicles where components have been lost or damaged exposing the silhouetted *Dunkelgelb* RAL 7028 base coat. This overall coat of *Dunkelgelb* RAL 7028 would be short lived as it did not comply with the instruction to use the material sparingly. Large areas of *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 now covered around 75% to 80% of the vehicle. The colour fields were clearly defined but the edges were not quite as precisely sprayed as those vehicles completed by Daimler-Benz with more diffuse borders to the colour fields. The patterns on initial vehicles completed after the reintroduction of these schemes varied before settling down to a variation of the "Classic" factory applied scheme used by Daimler-Benz.

A small run of Panthers assembled by M·A·N were used to trial *gummigefederte Stahllaufrollen* steel tyred road wheels with internal rubber cushioning. This wheel had been successfully used in the Tiger I *Ausf*. E and Tiger II *Ausf*. B; it was fitted with a new hub to allow it to be used for the Panther trial that was intended to test

10 It is unlikely a paint roller was used as this tool was only invented by Norman Breakey from Toronto, Canada in 1940 and was therefore not in widespread use in Germany during WWII Prof. Stuart Croll, A History of Paint.

11 One of the most noticeable differences between the scheme applied by Daimler-Benz on Panthers and by Henschel on Tiger II *Ausführung* B's is the contrasting spot overlay where Henschel used *Olivgrün* RAL 6003 spots on the *Dunkelgelb* RAL 7028 fields rather than the *Rotbraun* RAL 8017 spots that Daimler-Benz used.

12 The Panther allocated to the *Heeres-Waffenamt* and used as a platform for testing I.R. equipment.

its suitability for series production. The majority of these vehicles that served on the Western Front were issued to I./SS-Pz.Rgt. 1 and I./Pz.Rgt. 24. At least one of these was originally issued to I./Pz.Rgt. 15 on 4th October 1944; it was subsequently transferred to I./Pz.Rgt. 22 who lost it in Oberhoff en in Northern France at the end of operation *Nordwind*. The earliest recorded *Fgst.Nr.* from this trial run is Panther *Fgst.Nr.* 121032 and the latest is Panther *Fgst.Nr.* 121055, by coincidence both of these Panthers were amongst the group of 6 vehicles fitted with *gummigefederte Stahllaufrollen* issued to 2./SS-Pz.Rgt. 1 that were subsequently lost in the Ardennes Offensive[13]. This indicates a production run of at least 24 vehicles; however it is likely there were more than 24 Panthers completed with *gummigefederte Stahllaufrollen*.

M·A·N would commence fitting *Warmluftbeheizung* to the Panthers it completed part way through the trial run fitted with *gummigefederte Stahllaufrollen*. The earliest vehicle fitted with a *Warmluftbeheizung* completed by M·A·N is from this group of vehicles fitted with *gummigefederte Stahllaufrollen* recorded to date is Panther *Fgst. Nr.* 121032 completed on or about 21st September 1944. The *Warmluftbeheizung* is unusual in that it is one of the instances where a design modification was introduced to series production and a small number of the following vehicles in the production schedule from the same assembly plant were completed without it.

The size and shape of the colour fields on M·A·N Panthers finished with the "Classic" factory scheme were not as consistent as those on Panther completed by Daimler-Benz with more variety to the size shape and location of the colour fields on some vehicles. Panthers assembled by M·A·N still had a roughly painted fl at topped "A" in white applied to the starboard side of the travel lock's vertical front plate as well as the *Fgst.Nr.* stencilled on the glacis plate or very occasionally on the gun travel lock in black. A new stencil was used for the *Fgst.Nr.* on the majority of vehicles, however a few vehicles would still have this applied using the "*Prüßische IV 44 Ausgabe 3*" font". On the starboard side of the *Turm* there is a wavy line of *Dunkelgelb* RAL 7028 starting around the *Lost Erkennungstafel* poison gas indicator panel coming down diagonally towards a point just below the lower weld seam on the front interlock. Above this band a series of *Rotbraun* RAL 8017 troughs that start at the front of the *Turm* around the welded interlock and finish around the bend in the roof plate. The troughs on Panthers completed by M·A·N with the "Classic" factory pattern are much deeper than those on Panthers completed by Daimler-Benz. M·A·N had ceased application of any form of "Ambush" pattern overlay to all of the camouflage schemes they applied to Panthers when *Zimmerit* was discontinued. As was the case at Daimler-Benz and M.N.H. there was a supply of completed *Türme* that had a full or partial coating of *Zimmerit* that were mounted on *Fahrgestell* that did not have this coating. Two vehicles completed around this time were the Pz.Bef.Wg. Panthers *Fgst. Nr.* 121081 issued to Stab I./SS-Pz.Rgt. 1 which subsequently was lost in Ligneuville and the Panther from 4./SS-Pz.Rgt. 2 commanded by Hscha. Franz Frauscher that was knocked out in the centre of Manhay during the Ardennes Offensive[14]. This latter Panther can be identified as having been assembled by M·A·N from the *Turm's Zimmerit* distinctive roller applied ridged texture. The camouflage scheme applied to the Panthers completed by M.N.H. following the order to discontinue the application of *Zimmerit* remained unchanged with the vehicles still leaving the assembly plant with an "Ambush" disc overlay scheme.

Daimler-Benz would start to complete some Panthers fitted with an *Orterkompass* mount and *Lost Erkennungstafeln* around 19th September, though they would not fit these components to all of the Panthers they completed until the end of September[15]. M.N.H. would also start completing Panthers fitted with the *Orterkompass* mount at this point; it would be December before M.N.H. would complete vehicles with *Lost Erkennungstafeln* fitted.

Some Panther completed by M·A·N start to appear with the strengthened gun mantle previously only seen on some of the Panthers assembled by M.N.H. The Panthers completed by M·A·N with the strengthened gun mantle are predominantly but not exclusively Pz.Bef.Wg. Panthers. The older design of round mantle (021 St 50255) continued to be fitted to the majority of the Panthers assembled by both M·A·N and M.N.H. Instructions were issued to the assembly plants to fit a lengthened rain guard over the gunsight aperture as troops reported that driving rain was still entering the gunsight aperture which had a detrimental effect on the combat capability of the vehicle.

A new bracket for mounting the extension rods for the *Sternantenne D* was introduced to production by M·A·N. The original brackets consisted of a socket that the base of the extension rod fitted into and a simple cylinder which had a split face that could be tightened with a wing nut to secure the extension rod in place. These brackets were welded to the starboard *Gepäckkasten* inboard side. The new bracket consisted of a single tube which incorporated the socket at the base with the split section and wing nut at the top. The new bracket held the rods more securely and was easier to fit. A directive regarding the preparation of a limited number of I.R. capable Panthers was issued, the letter F was to be stamped at the end of the *Fgst.Nr.* of these vehicles on the serial number plate. The letter "F" indicated that the vehicle had been prepared for use with FG 1250 *Ziel-und Kommandanten-Optik* infra red night vision equipment. M.N.H. completed twenty I.R. prepared Panthers in September.

13 2./SS-Pz.Rgt. 1 were issued Panther *Fgst.Nr.* 121032 tactical number 201, Panther *Fgst.Nr.* 121046, Panther *Fgst.Nr.* 121047 tactical number 211, Panther *Fgst.Nr.* 121051 at Honsfeld, Panther *Fgst.Nr.* 121052 tactical number 231 and Panther *Fgst.Nr.* 121055. Panther tactical number 221 abandoned in the centre of La Gleize is either *Fgst. Nr.* 121046 or *Fgst.Nr.* 121055.

14 Monfort: *La Bataille des Carrefours.*

15 Panther *Fgst.Nr.* 124726 (*Panzer Tracts No.5-3*) and Panther tactical number 133 (*Panzerwrecks 7*) are both September production Panthers with no *Zimmerit*, *Orterkompass* mount or *Lost Erkennungstafeln*, they have also both been prepared for I.R. use. At least two Panthers lost during the Ardennes Offensive that were issued to 2./SS-Pz.Rgt. 1 tactical numbers 202 and 232 have a *Zimmerit* coating on the turret as well as *Lost Erkennungstafeln* and *Orterkompass* mounts.

Daimler-Benz had already completed six of these vehicles which were issued to I./Pz.Lehr-Rgt. 130 on 15th August; this unit would be attached to Pz.Brig.113 during their operations in Northern France. The earliest of these six I.R. prepared Panthers was *Fgst.Nr.* 124528F completed on or about 8th July 1944. There were other I.R. prepared Panthers completed by Daimler-Benz, one of these was completed on or about 13th September. This Panther is completely devoid of painted markings and tool stowage indicating it was used for testing and evaluation purposes and was not accepted for service with the *Wehrmacht*. The last three digits of the *Fahrgestell* number 726 have been chalked on to the glacis plate. This Panther is devoid of *Zimmerit* and has the "Classic" factory applied camouflage scheme with a contrasting spot overlay. It is not known whether the particular configuration for the I.R. equipment fitted to this vehicle when it was photographed is the final arrangement accepted by the *Heeres-Waffenamt* for combat operations[16]. The external modifications made to the Panther to prepare it for potential I.R. use consisted of fitting a dedicated armoured stowage box in place of the starboard *Gepäckkasten*. The mounting height of this box could help indicate which assembly plant completed the vehicle as both Daimler-Benz and M.N.H. mounted the box so that the bottom edge was at the same height as the sponson floor above the tracks while vehicles assembled by M·A·N aligned the top edge of the box with the upper edge of the *Wanne* rear plate. The *Turm* had an aperture for a steel band or tape that was used to align the main gun on the target after its acquisition using the I.R. *Bildwandler* sight by the commander. The aperture and the connector for the sighting tape were protected by an armoured horseshoe welded to the *Turm* roof. The external hatch handle on the commander's cupola was removed or not fitted to I.R. prepared Panthers. Two rectangular steel mounting points were welded to the starboard side of the gun mantle casting; these blocks were drilled and tapped to allow the I.R. lamp mounting plate to be fitted to the Panther's gun mantle. The plate was held in place by four 30mm bolts and had a weatherproof socket that would be powered via a lead from the *Turm*. The mounting point for the I.R. lamp has the standard Bosch electrical connection with four pins as used for the Bosch headlamp.

October 1944

M.N.H. ceased the application of the ambush "Disc" overlay camouflage pattern in October 1944. A large number of Panthers finished in this camouflage scheme would be delivered to the troops with a number of these Panthers going to I./SS-Pz.Rgt. 1, I./Pz.Lehr-Rgt. 130, II./Pz.Rgt. 33, I./SS-Pz.Rgt. 10, I./Pz.Rgt. 31 and I./Pz.Rgt. 11. The *Heeres-Waffenamt* would inform M.N.H. on 20th September that shade cards for the *Dunkelgelb* RAL 7028, *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 would be sent to M.N.H.'s *Malermeister* (Master Painter) Hubert. It is worth noting that the shade cards were part of a kit supplied for use during the *Heeres-Abnahmestelle* procedure. This would be used by the assembly plants inspectors as well as the *Heeres-Waffenamt* inspectors and would allow them to accurately compare the colours used on the vehicle with the approved colours on the shade cards. If these were not within the acceptable tolerances specified by the *Heeres-Waffenamt* then the vehicle would need to be repainted in the correct colours.

A new camouflage scheme would be introduced that was unique to Panthers assembled by M.N.H.[17] This consisted of stripes or bands of colour crossing the vehicle diagonally from one side to the other including the *Fahrgestell* and *Turm* roof. The basic principles of the pattern would remain the same from this point on to the end of the war. The initial version of this pattern is characterised by four *Dunkelgelb* RAL 7018 diagonal stripes on the glacis plate and depending on where the painters had started, either three or four stripes on the turret side. These *Dunkelgelb* stripes did not always run parallel with the *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 stripes. The pattern did evolve with subtle changes over time; these coincide with modifications to the design implemented by M.N.H. that provide a time line for the evolution of the camouflage scheme.

A careful examination of Panthers with this new camouflage scheme in period photographs has allowed us to determine that the *Olivgrün* RAL 6003 component of this camouflage scheme was applied first. The *Rotbraun* RAL 8017 component was the next colour to be applied. It is not possible to determine from photographs whether the initial coat of *Olivgrün* RAL 6003 was an overall coat but that the *Rotbraun* RAL 8017 was then applied on top of. It is probable that both colours were applied in alternating bands that covered the vehicle i.e. that there was no complete coat of *Olivgrün* RAL 6003 prior to the application of *Rotbraun* RAL 8017, only those areas that would be visible on the finished vehicle receiving a coat of paint reducing the material necessary to cover the vehicle. The last coloured bands to be applied were the *Dunkelgelb* RAL 7028 stripes; these crossed the vehicle at a slightly different angle to the bands of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 so that these colours were not separated by a *Dunkelgelb* RAL 7028 border. The vehicle's 7.5cm Kw.K.42 L/70 main armament was delivered to the assembly plants in either *Dunkelgelb* RAL 7028 or a dark grey coloured heat resistant lacquer. M.N.H. would deliver completed Panthers where the gun had originally been delivered in *Dunkelgelb* RAL 7028 with almost all of this obscured by a heavy application of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017, if the gun was delivered in the dark grey lacquer then a lighter application of *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 was applied leaving some of the dark grey lacquer still visible. A supplementary instruction was issued to M.N.H. by telephone and subsequently recorded in a memo on 31st October regarding the sparing application of "*Braun, Grün and Gelb*" camouflage

16 A *Schürze* plate and *Gepäckkasten* from a M.N.H. assembled post October 1944 Panther *Ausf*. G were found with the original camouflage intact in Székesfehérvár in Hungary and found to have separate bands of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017, a *Dunkelgelb* RAL 7028 stripe was then sprayed over the border between the two colours where they adjoined each other..

17 M.N.H. would also complete the Jagdpanthers they assembled in this striped camouflage scheme. MIAG would also apply a similar striped camouflage scheme to the Jagdpanthers they would complete.

The intermediate pattern of strengthened gun mantle was fitted to a significant number of *Pz.Bef.Wg.* Panthers as well a number of standard Panthers assembled by M·A·N between September and October 1944. The last vehicle fitted with this gun mantle identified to date that was completed by M·A·N on or about 28th October is Panther *Fgst.Nr.* 121163. This Panther was issued to I./SS-Pz.Rgt. 2 and was knocked out in the centre of Grandmenil during the Ardennes Offensive in December 1944. The earliest Panther completed by M·A·N with the new strengthened part (021 St 50258) is Panther *Fgst.Nr.* 121165 completed around 29th October prior to being issued to 2./Pz.Rgt. 15. (NARA via Darren Neely)

Panther tactical number 121 from 1./SS-Pz.Rgt. 9 was knocked out by a 57mm anti tank gun manned by troops from the U.S. 331st Inf. Rgt. in front of Mr. Joseph Lemaire's house on the outskirts of Langlire in Belgium during the Ardennes Offensive in late December 1944. The combination of build features, factory applied camouflage and the location of the Balkenkreuze national markings enable us to determine that this Panther was completed by M·A·N between 28th October and 28th November 1944 despite the fact that the *Fahrgestell* number is obscured by snow. It is fitted with the 600mm *Leiträder* and has a strengthened " Chin" gun mantle (021 St 50258). It has been fitted with standard exhaust stacks that have sheet metal guards and has a Warmluftbeheizung crew compartment heater. It has been painted in the *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 "Classic" factory applied camouflage scheme at the M·A·N plant in Nürnberg. (NARA via Darren Neely)

paints directly over the red primer according to the template supplied, this memo included the instruction that the interior compartments of *Panzer Wannen* were no longer to receive any further coats of paint other than that applied at the armour manufacturers' premises.

Maybach had written to the *Heeres-Waffenamt* regarding leaks found in the new water connections that had recently been introduced on the HL230 motor. The cause of these leaks was found to be damage to the water connections caused by mishandling during installation. The *Heeres-Waffenamt* wrote to the assembly plants on 9th October to highlight this problem and take appropriate care when installing these components.

In response to complaints from the troops the *Heeres-Waffenamt* wrote to the assembly firms on 9th October regarding the failure of the seals on the driver and radio operator's roof plate. The contact surfaces on the roof plate and the *Wanne* were now to be coated with a liquid rubber solution that would retain its elasticity when cured and absorb any movement between the *Wanne* and the roof plate.

The "Chin" gun mantle (021 St 50258) was introduced to production in October. Both the new "Chin" mantle and the older round mantle (021 St 50255) would continue to be fitted up to the end of the war. M.N.H. was the first assembly plant to complete some vehicles with this new part and stop fitting the intermediate strengthened gun mantle. M·A·N was still completing Panthers with the intermediate strengthened gun mantle until supplies of the new part became available to them, completing Panther *Fgst.Nr.* 121163[18] with intermediate mantle on or about 28th October. The earliest Panther completed by M·A·N with the new strengthened part (021 St 50258) is Panther *Fgst.Nr.* 121165[19] completed around 29th October, Daimler-Benz would also start completing Panthers with the new gun mantle around this time.

A new 665mm diameter self cleaning *Leitrad* (idler wheel) was introduced by M·A·N, the earliest example of a Panther completed by M·A·N identified with the new *Leiträder* (idler wheels) is Panther *Fgst.Nr.* 121137[20] completed on or about 18th October. The new large diameter *Leitrad* (idler wheel) was never fitted to the Panther *Ausf*. G series by Daimler-Benz. The only photographs showing Panthers being assembled by Daimler-Benz with this *Leitrad* are the very small number of *Ausf*. F *Wanne* still on the assembly line at the firm's premises in Berlin Marienfelde, after it was overrun at the end of the war. The last Panthers completed by Daimler-Benz were issued to I./Pz.Rgt. 29 who were attached to Pz.Div. Müncheberg for the final defence of Berlin still have the early 600mm diameter *Leitrad* design which originated from the *Ausf*. D. The *Warmluftbeheizung* (crew compartment heater) was officially approved for series production, as we have seen it was already being installed by all of the assembly plants prior to this instruction. The *Lost Erkennungstafeln* (poison gas detector panels) were also officially approved for series production, Panthers completed by M·A·N and Daimler-Benz would have these fitted prior to the receipt of this instruction from the *Heeres-Waffenamt*. The contrasting spot overlay that Daimler-Benz would apply over the "Classic" factory pattern was discontinued towards the end of October. Around the same time Daimler-Benz would stop fitting the cast armoured guard and start fitting the new forged armoured guard for the exhaust elbow. Panther *Fgst.Nr.* 1248304 completed by Daimler-Benz on or about 18th October has the forged exhaust armoured guard. The majority of Panthers completed by M·A·N now have their variation of the "Classic" factory applied camouflage pattern.

A significant change is made to the equipment fitted to Panthers at the assembly lines, photographs taken in Grafenwöhr show lines of new Panthers which are bereft of all stowage that have just arrived. The crews sit amongst rows of equipment that has been laid out for each new vehicle. The rows consist of two bundles of spare tracks that have been joined in twos, vehicle jack and jack block, spare track pins, a full set of *Schürzen* for each vehicle along with the various internal tool boxes. The crew of the vehicle still in the process of being handed over can be seen fixing the spare tracks to the brackets for these on their new Panthers.

As a result of the inherent problems with glowing exhaust stacks and flames from gasoline that had failed to fully combust revealing the Panther's position at night and the failure of the sheet metal guards fitted over these from May 1944 to completely eliminate the problem, a set of *Flammenvernichter* flame suppressing exhaust stacks were officially approved for production in October. There is no evidence that any of the assembly plants completed Panthers fitted with *Flammenvernichter* in October 1944.

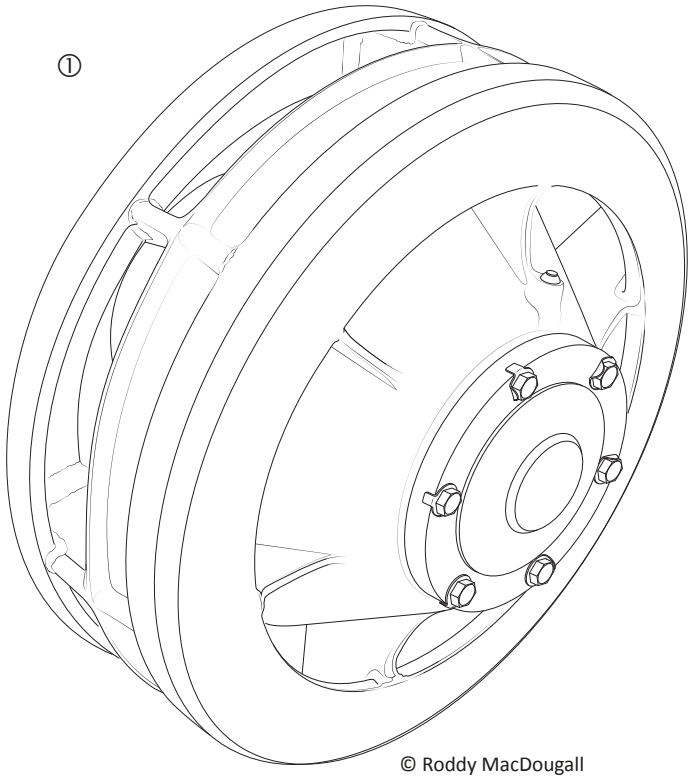
Instructions were issued to the assembly plants by *Wa.Prüf 6 Pz III* to stop fitting the rear *Stoßdämpfer* (shock absorbers) in order to simplify production on 7th October 1944. The rear levers 48393 U that connected the *Stoßdämpfer* to the swing arms were deleted along with the lubrication lines. The starboard side *Stoßdämpfer* cover on the fire wall i.e. metal box 021 D 51104 U1 was retained. The bolts 021 E 48304-12 in the *Wanne* for securing the *Stoßdämpfer* were to be cut to over a total length of 112mm and are to be welded on the inside. M.N.H. dropped these from production starting with Panther *Fgst.Nr.* 128696, vehicle 1446 from order 60 096 completed on 12th October. The armour manufacturers who were responsible for welding in the sleeves and braces for the mounting points for the *Stoßdämpfer* were instructed not to change the design until further notice but this was not expected to happen until the end of 1944 at the earliest. The external cap for the *Stoßdämpfer* was still present

18 Panther *Fgst.Nr.* 121163 issued to I./SS-Pz.Rgt. 2 abandoned in Grandmenil during the Ardennes Offensive.

19 Panther *Fgst.Nr.* 121165 issued to I./Pz.Rgt. 15.

20 Panther *Fgst.Nr.* 121137 issued to I./SS-Pz.Rgt. 12 and knocked out in Krinkelt-Rocherath during the Ardennes Offensive.

Leiträder (Idler Wheels)



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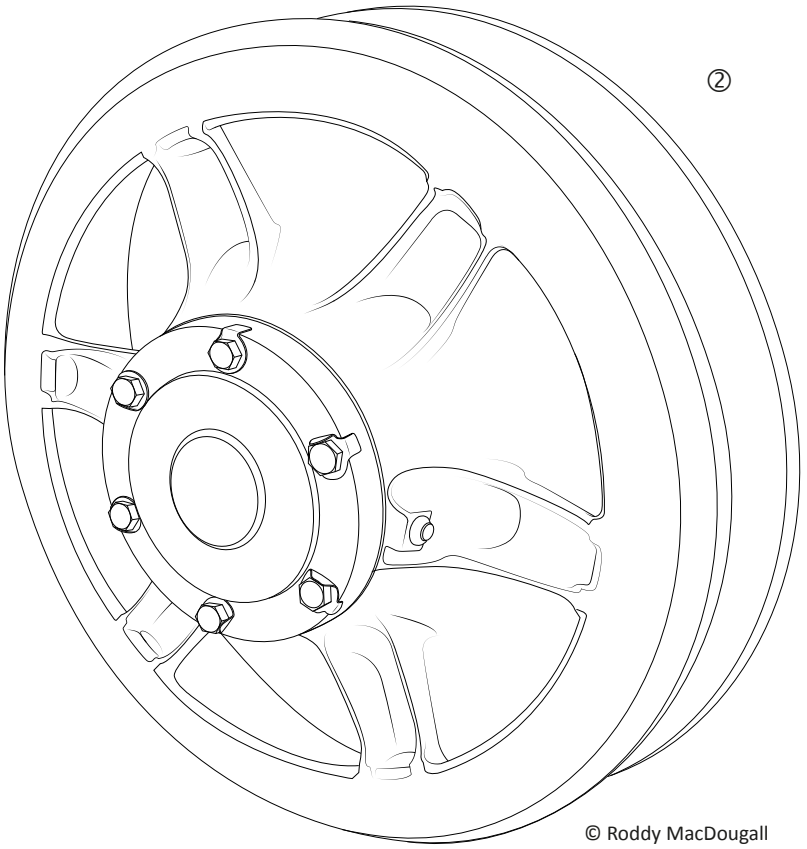
①The new 665mm diameter self cleaning *Leitrad* (idler wheel) was first introduced by M·A·N, the earliest example of a Panther *Ausführung* G completed by M·A·N identified with the new Leiträder (idler wheels) is Panther *Fgst.Nr.* 121137 completed on or about 18th October. This Panther was issued to 1./SS-Pz.Rgt. 12. and had the tactical number 125. This Panther was knocked out in the village of Rocherath during the Ardennes Offensive in December 1944 where it was extensively photographed over the following 18 months.

The original ② 600mm diameter Leitrad design which originated from the *Versuchs Fahrgestell* and the *Ausführung* D and A series production Panthers remained in production until the end of the war. It was replaced with a new design starting in October 1944 by both M·A·N and M.N.H. The new large diameter *Leitrad* (idler wheel) was never fitted to the Panther *Ausführung* G by Daimler-Benz. The only photographs showing Panthers being assembled by Daimler-Benz with these *leiträder* are the very small number of *Ausführung* F Wannen still on the assembly line at the firm's premises in Berlin Marienfelde after it was overrun at the end of the war. The last Panthers to be completed by Daimler-Benz in April 1945 were issued to I./Pz.Rgt. 29 who were attached to Pz.Div. Müncheberg for the final defence of Berlin.



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on most of the last *Ausführung* G Panthers assembled[21]. Only M.N.H. appears to have received a delivery of *Wannen* without apertures for the rear *Stoßdämpfer* towards the end of the war.

The armour manufacturers had started to implement a change to the design of the bullet splash guard that surrounded the *Wanne* ventilator, the steel profile had previously been welded outside the ventilator armoured cap and was readily visible, the new design was circular and installed within the footprint of the armoured cover so that it is difficult to make out in period photos. Panthers with both patterns of splash guard were completed by Daimler-Benz in October 1944[22]. The armour manufacturers would not all complete the change to the new splash guard design until December 1944; Daimler-Benz would still complete some Panthers in November[23] and December with the original square design.

November 1944

Zimmerit Combustion Tests

A series of tests were conducted at the Heeres-Waffenamt testing facilities at Hillersleben-Salchau to determine whether rumours that *Zimmerit* paste could be ignited leading to a sustained fire resulting in the potential loss of the vehicle by the heat generated from the kinetic energy of rounds striking the armour plate, or by exposure to various types of naked flame that might be encountered while in service. It should be noted that the application of *Zimmerit* paste had already been discontinued in September and there is insufficient surviving information to determine whether this was a temporary decision pending the outcome of these tests or to assuage the concern of troops still equipped with vehicles that had a *Zimmerit* coating. The fact that there were no instructions to the assembly plants to recommence applying *Zimmerit* paste suggests that the latter reason was why this series of tests were conducted two months after the *Zimmerit* coating had been discontinued.

A report was prepared by Ing. Ehleben from *Wa Prüf 1 (Bewaffnung und Munition) herausge¬gebenen „Arbeitsnachrichten"* dated 19th November, 1944 titled *"Erprobung der Hafthohlladungs-Schutzmasse bezüglich inbrandsetzen von Panzerkampfwagen"* (Testing magnetic shaped charge Protection Compound, *Zimmerit* with regard to its combustion on Tanks). This report detailed the tests completed and their results with the vehicles at ambient temperatures, the tests were then repeated after an internal fire had been set to ascertain whether an increase in temperature would cause any solvents still present to evaporate was a factor in the combustibility of *Zimmerit* paste.

As there were no suitable German tanks available for the tests, two captured T 34 tanks were provided that were coated with *Zimmerit* paste. On one of the T 34's the *Zimmerit* was applied in several layers, with the intermediate layer being heated with a blowtorch for faster curing in the approved manner by an expert from the manufacturing firm. The other T 34 had the compound applied in a single layer by the firing range staff without the use of a blowtorch to assist in curing.

Flammability tests:

- **Ambient temperature amour tests:** The first flammability tests using blowtorch and welding machine were conducted on 9th November 1944. The T 34 that had been coated by the factory expert was allowed to cure for 4 days prior to the test while the second T 34 was allowed 3 days. The *Zimmerit* surface on both vehicles had hardened but was still somewhat plastic/soft below this. The smell of the solvent was clearly perceptible in the vicinity of the tanks. The tanks had a temperature of circa 5°
- **Result:** The *Zimmerit* surface was exposed to the naked flame from both the blowtorch and the welding torch for circa 30 seconds. The test area exhibited some weak tongues of flame during this test while the heat source was applied and a light afterglow for 3-4 seconds after the heat source was removed. There was no prolonged burning or smouldering beyond this time and there was no further spread of the flame beyond the area tested.

- **Warmed armour tests:** After allowing 2 more days of drying time the flammability tests were repeated on 11th November after the tanks had their armour components brought up to a temperature of circa 35° with a log fire in the fighting compartment used to induce an increased evaporation of any solvents present.
- **Result:** As with the ambient armoured components the flames on the *Zimmerit* layer burned on after the removal of the test flame but for up to 20 seconds before fully extinguishing.

A flammability test conducted on fresh *Zimmerit* paste caused a fire on the whole surface that had to be extinguished by smothering with earth.

Ballistic tests:

On 11th November 1944 the two captured T 34 tanks coated with *Zimmerit* paste were fired on with a 7.5cm Pak 40 and a 10.5cm le. F.H. 18 using various types of

21 Panther *Fgst.Nr.* 121455 assembled in April 1945 still has the external plug for the rear shock absorbers. Several I./Pz.Rgt. 29 assembled by Daimler-Benz that fought in the final battle for Berlin.

22 Panther *Fgst.Nr.* 124830 completed on or about 18th October was issued to I./SS-Pz.Rgt. 2 and was abandoned in Grandmenil during the Ardennes Offensive.

23 Panther *Fgst.Nr.* 124932 completed by Daimler-Benz on or about 16th November 1944.

ammunition. The *Zimmerit* coating applied in the approved multiple layer method now had 6 days to fully cure and the paste applied in a single layer had 5 days to cure. The armour casing was brought up to a temperature of about 30-35° by lighting a log fire in the fighting compartment.

The firing trials were carried out at a range of 250m with the following ammunition:

7.5 cm Pzgr. 39, blind ohne Leuchtspur
7.5 cm Pzgr. 39, scharf mit Leuchtspur
7.5 cm Pzgr. APC M 61 Proj (a) mit Sprldg u. Leuchtspur
7.5 cm Gr. 38 HUG
7.5 cm Gr. 34

The Pzgr. were fired so that both penetrations and ricochets occurred.

- **Result:** Combustion of *Zimmerit* layer was not achieved in any of these tests. The layer was chipped around the respective shell strikes. The Gr. rounds from the le. F.H. 18 sprayed globules of phosphorus over the *Zimmerit* layer which then burnt on until the chemical incendiary burnt out, however there was no sustained combustion of the *Zimmerit* paste.

Summary:

The flammability tests conducted on both warm and cold armoured components and ballistic tests with different projectile types on warm armour indicate that *Zimmerit* paste cannot be ignited after it has been allowed a three to six days period to fully harden following its application. However, there is the possibility that the troops in isolated cases have painted their vehicles with a locally procured paint containing potentially flammable components that favoured combustion of *Zimmerit* paste when the armour plate with this coating was struck by enemy fire.

Further firing trials were planned with *Zimmerit* paste on wrecked Panthers and complete Panthers. These experiments can only be carried out only after the vehicles are provided by Wa.Prüf 6, however it is no known if these were ever completed[24].

November Design Revisions

The striped camouflage scheme applied by M.N.H. would be altered so that the *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 diagonal stripes are now separated by *Dunkelgelb* RAL 7028 stripe that borders the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 stripes. This change is characterised by additional *Dunkelgelb* RAL 7028 stripes on the glacis plate and *Turm* sides. The stripes are now more uniform in appearance, as production progresses through to 1945 these stripes become straighter to the point that they look as though they have been applied using a straight edge as a guide. They have a much tighter spray pattern that viewed from any more than a few meters distance appears to have a hard edge as though applied over a mask or with a roller or brush. This is on a par with the tightly sprayed edges achieved by Daimler-Benz, neither of these assembly firms would complete Panthers with camouflage applied with a true hard or sharp edge.

On 6th November the *Heeres-Waffenamt* instructed M.N.H. that they had been installing the *Anschlagböcke* (bump stops) 48393 U5 with 5 rubber buffers per bolt instead of 3 rubber buffers per bolt as per the correct specification for this part. All available *Fahrgestelle* in Hall 2 of the plant were to have Belleville washers installed on the *Anschlagböcke* immediately to the correct specification which was attached.

- 4 Anschlagböcke 48393-4 and 12 bolts 48393-19
- 2 Anschlagböcke 48393 U5 and 18 Belleville washers 48303-69

The *Heeres-Waffenamt* wrote to the assembly plants several times between 13th and 17th November regarding shortages of road wheels swing arms. They were forced to amend the instructions to the assembly plants when it became apparent there would be insufficient supplies of the alternative components that had been selected to replace those used since the specification was amended on 13th June 1944. The specification for the swing arms that was eventually decided was as follows:

- Road wheel station1. port and starboard swing arm: reinforced Siepmann swing arms 48393-40 (basic component 48393-15, reworking needed due to discontinuation of the internal bushings according to drawing TuB 21501);
- Road wheel station 2. port and starboard swing arm: reinforced Bochumer-Vereins swing arms 48393-14 (provided with inner and outer bushings);
- Road wheel stations 7. port swing arm and 8. starboard swing arm: selected reinforced Siepmann swing arms 48393-40 (basic component 48393-15, (alteration needed due to discontinuation of the internal bushings according to drawing TuB 21501) for installation of the *Anschlagböcke* (bump stops);
- All other swing arms: normal hollow Siepmann swing arms 48303-30.

M.N.H. was instructed to use this swing arm arrangement starting from vehicle 1552, the 26th vehicle from order 60 097, *Fgst.Nr.* 128802 completed on 16th November. The following additional amendment was sent to the assembly plants on 17th November following a design change meeting in Berlin:

1. Both *Anschlagböcke* (bump stops 48393-4) located near the 7th port swing arm and the 8th starboard swing arm are to be discontinued. The apertures for their attachment bolts were to be closed with countersunk bolts 38318-4 (replacing countersunk bolts 8393-35) and 38318-6 instead of taper pins bolts 48393-36. The

24 Waffen Revue 27 Waffen Lexicon 1980-100-1

countersunk bolts are to be covered with Teroson. Four pieces of each bolt are needed per device.

2. On the 7th port swing arm and the 8th starboard swing arm it was permissible to fit either the reinforced Siepmann swing arm 48393-40 or the normal Siepmann swing arm 48303-30 when the *Anschlagböcke* (bump stops) listed under point 1 were removed. The regular swing arms are only to be equipped with light hubs and the normal I or A (I = *Inneren* or A = *Äußeren*) *Radscheiben* (road wheel discs) with normal rims. The instructions as noted down in our memo from 13.11.44 remain valid for the November production. The *Anschlagböcke* (bump stops) on the 7th and 8th swing arm were discontinued due to supply problems with the Belleville washers.

3. After discontinuation of the *Stoßdämpfer* (shock absorber), the shared *Anschlagböcke* (bump stop) cover 51103 U3 on the 7th swing arm was to be replaced by the individual *Anschlagböcke* cover 48303 U4. Therefore only 1 Anschlagböcke cover U3 is needed on the 2nd swing arm right.

On 18th November M.N.H. were instructed to rework the Panthers still at the assembly plant that were scheduled for completion in November and were prepared for use with FG 1250 night vision equipment back to standard Ausführung G vehicles. This included the installation of the stowage box on the rear starboard side of the *Wanne*, exchanging of the stand for the GG400 generator for a three-round ammunition box, elimination of the holder for the observation equipment in the turret and removal of the electrical accumulator, inverter and high-voltage transformer.

They were also notified that the number of vehicles to be completed in December that were to be prepared for use with FG 1250 equipment had been reduced to 30 and that revised documentation for these would be issued shortly.

On 20th November a further instruction regarding the FG 1250 prepared Panthers was sent to M.N.H. :

"We refer to our memo from 18th November dealing with this subject and need to clarify that after today's notification from the Amt, all vehicles that had been prepared for with FG 1250 equipment need to be completely stripped of these FG 1250 components. The vehicles need to be delivered in a pure Ausführung "G" condition."

The emphasis in point 2 above that only normal road wheels and light hubs could be used with the unreinforced swing arms indicates that the availability of reinforced suspension components is the reason that *gummigefederte Stahllaufrollen*, which were considerably heavier than the standard road wheels and hubs, were not installed on all series production Panthers following the trial run completed in September.

M·A·N would also introduce a new camouflage scheme towards the end of November. Panther *Fgst.Nr.* 121262 was completed by M·A·N on or about 27th November with the "Classic" factory scheme applied and is the last recorded vehicle to be completed by M·A·N with this camouflage scheme[25]. The new scheme consisted mainly of bands of colour that crossed the vehicle vertically, the concept is similar to the M.N.H. striped scheme but the execution is dissimilar so that the two schemes can not be confused. The colour fields on the new M·A·N scheme undulate significantly more and do not have the consistency of form apparent on Panthers completed by M.N.H. at this point. The new camouflage scheme would replace the variations of the "Classic" factory scheme that M·A·N had used on the majority of their Panthers since September.

the end of November, Panther *Fgst.Nr.* 121264 was completed on or about 28th November with this design change, it is also finished in the new camouflage scheme as well as Panther tactical number 301 from I./Pz.Rgt. 3 lost at Clervaux in Luxembourg during the Ardennes Offensive which is one of the last Panthers finished in the "Classic" factory scheme by M·A·N (see page 201)[26]. The first Panthers assembled by Daimler-Benz with the welded exhaust armoured guards are completed in November 1944[27]. M.N.H. start to complete some Panthers with the striped camouflage running in the opposite direction, i.e. from the lower left corner to the upper right, the reason for this change is not known but it is likely that it has more to do with working practices or staffing rather than a change of instruction as both versions of this pattern can be seen on newly completed vehicles up to the end of production at the plant. A very small number of vehicles would be completed with chevron camouflage stripes with the apex of the stripe at the upper hull changing direction on the turret. This variation would continue to be intermittently seen on new vehicles after the basic pattern evolved right up to the end of production. Finally, as initiated by orders dated November 1944, but not to go into full effect until June 1945, the Panzers were to receive a base coat of *Dunkelgrün* RAL 6003. A camouflage pattern was to be created at the assembly plant by spraying on *Rotbraun* RAL 8017 or *Dunkelgelb* RAL 7028 with sharp contours[28].

On 28th November M.N.H. sent the *Heeres-Waffenamt* a list of design changes that had recently been or would shortly be incorporated in the series production Panthers along with their *Fahrgestell* numbers and the contract or order number.

1. The oil seal according to drawing 21 C 70046 (PV-G 575/576) in the cooling

25 Panther *Fgst.Nr.* 121262 was knocked out at Hoscheid in Luxembourg during the Ardennes Offensive and issued to I./Pz.Lehr-Rgt. 130.

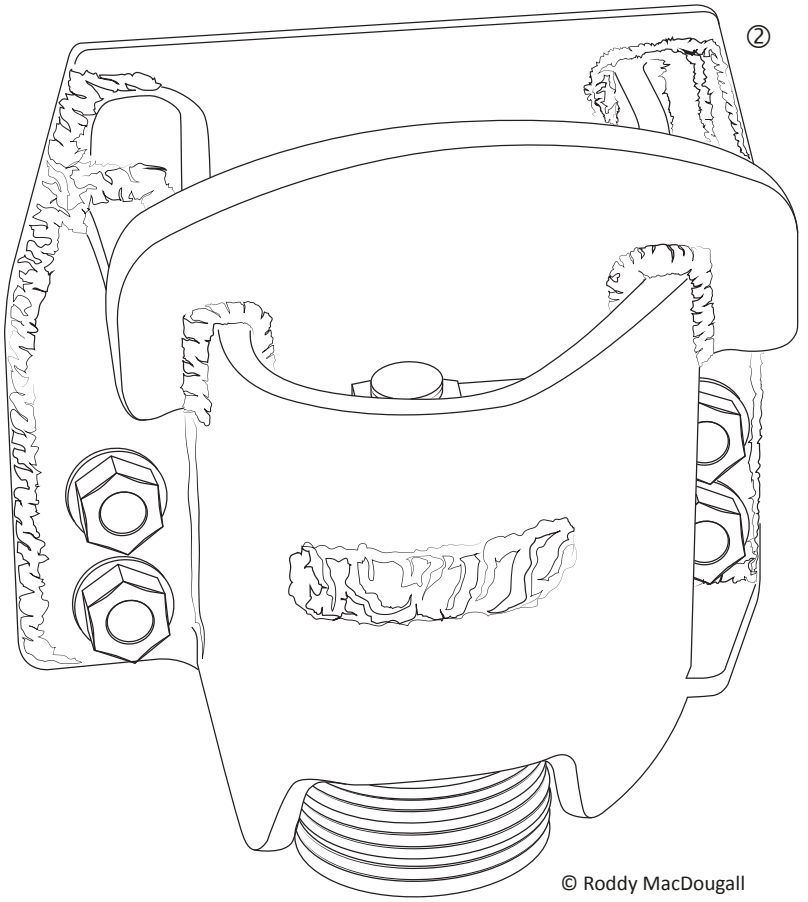
26 Panther *Fgst.Nr.* 121264 was issued to I./Pz.Rgt. 16 and was lost at Menil-Favay during the Ardennes Offensive. A significant number of the Panthers in this unit were completed with *Flammenvernichter* by M·A·N in late December or early January and were subsequently lost during the Ardennes Offensive.

27 Panther *Fgst.Nr.* 124932 completed by Daimler-Benz on or about 16th November 1944 has the welded exhaust elbow armour.

28 Article by Tom L. Jentz on "Missing Lynx" internet discussion group.

Anschlagböcke & Jochen (Bump stops)

Bump stops are designed to improve the ride while protecting the vehicle's suspension which in the case of the Panther prevented the vehicle from "bottoming out" or the *Wanne* floor hitting the ground. Another function of this protection that was just as important was limiting the travel of the swing arms which prevented damage to the torsion bars connected to these. There were ①four *Anschlagböcke* (bump stop 48393-4) fitted to the lower sides of the Panther Wanne. These can also be found described as *Jochen* (yokes) in period documents. ②There was an additional two *Anschlagböcke* (bump stop 48393 U5), one on each side of the *Wanne* at the front of the vehicle. Both of these designs used Belleville washers (48303-69) a type of spring that resembles a semi conical washer, these had additional rubber packers between them.



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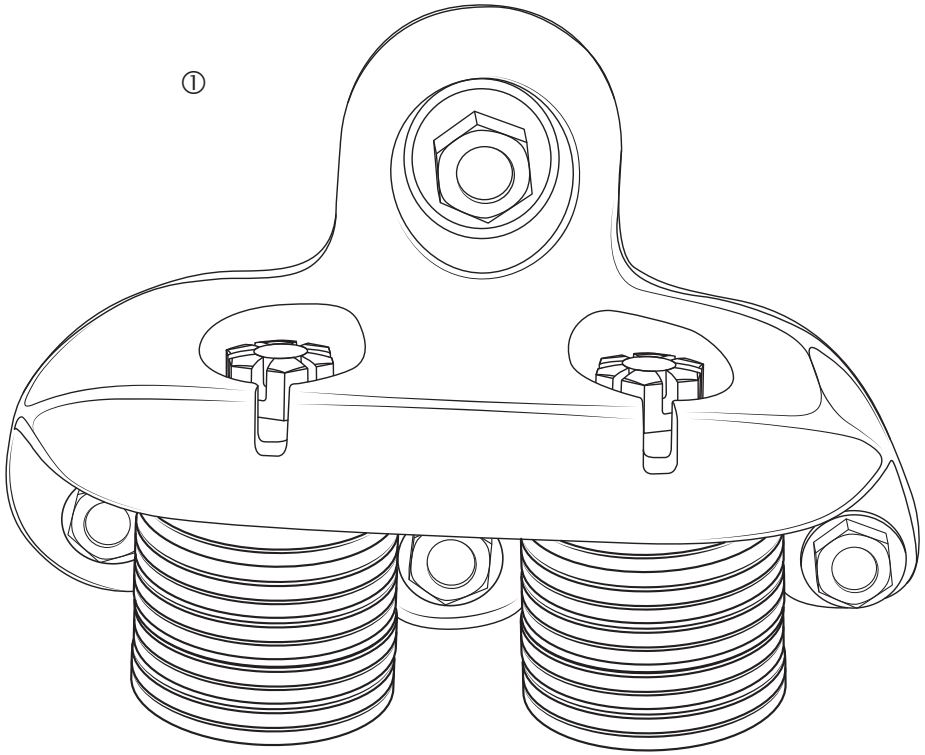

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group from vehicle with *Fgst.Nr.* 128852 (the 76th vehicle from order 60 097) onwards.

2. *Warmluftbeheizung* (crew compartment heater). In order to control the air fl ow inlet it is necessary to install the covers 5113C U71 till U74 on the starboard grills from vehicle with *Fgst.Nr.*128877 (the 101st vehicle from order 60 097) onwards.

3. *Flammenvernichter* (flame suppressors). Will be installed from vehicle *Fgst.Nr.* 128896 (the 120th vehicle from order 60 097) onwards according to drawing 51126 U7. This Panther was scheduled to be completed in December.

4. Separate lubrication for the ball housing and the adjustment spindle of the track tensioning system will be installed from vehicle with *Fgst.Nr.*128816 onwards (the 40th vehicle from order 60 097).

5. The modified mount for the cover plates for the warm air heating's protection cap will be introduced from vehicle with *Fgst.Nr.*128827 onwards (the 51st vehicle from order 60 097).

6. The alternate bearing in the idler wheels with the deep-groove ball bearing 6222 instead of the WuL 110 bearings would be introduced on *Fahrgestell* numbers 128782 to 128901 (the 6th to the 125th vehicle from order 60 097). The Panthers in the following series would revert to the WuL 110 bearings.

Wa Prüf 6 rescinded the instructions regarding the discontinuation of the *Anschlagböcke* (bump stops) on the 7th port and 8th starboard swing arms issued on 18th November. A decision would be made in the following week as to whether the assembly plants could expect to continue fitting these components in the future. M.N.H. reported back that they had discontinued the installation of the *Anschlagböcke* on the Panther *Ausführung* G from *Fgst.Nr.* 128852 up to and including 128863 and would recommence installation of *Anschlagböcke* from vehicle *Fgst.Nr.* 128864 completed on or around 4th December onwards. The *Heeres-Waffenamt* issued detailed instructions regarding modifying the driver's seat to the assembly plants on 30th November 1944. The detail of the instructions issued to M.N.H. read as follows:

"Rework on the Fahrgestell (chassis) due to the provisional installation of the raised driver's seat.
We have received order from the Amt to rework the Fahrgestell (chassis) for the provisional installation of the raised seat. According to drawing 48 789 0469 this work includes:

1. *Left and right steering lever (48378 U41 and U42) receive two slots and a cut on the handgrips to accommodate the extensions (image 1 in aforementioned drawing)*
2. *A 12mm diameter hole is to be drilled in the gearbox shifting lever (image 2 in the aforementioned drawing)The cover 51102 U13 has to be cut out and brackets 51102-62 and -73 are each to receive a 9mm diameter hole.*

These modifications will be introduced from Fgst.Nr. 128862 onwards. For this purpose, it is necessary that the assembly line (Master Ebeling) and the preassembly (Master Braubach) supply the steering lever under point 1 and the shifting lever under point 2 to the mechanical reworking unit (Mister Bakemeier). The modifications listed under point 3 have to be temporarily executed on the assembly line (Master Ebeling) until the corresponding parts can be delivered. Detail drawing 48 789 0469 has been issued to Mister Bakemeier on 30th November and detail drawing 48 789 0469 for the modifications listed under point 3 has been issued to Mister Stürmer on 30th November by Abt.703."

M.N.H. would not start completing Panthers with the new large diameter self cleaning *Leitrad* (idler wheel) until the end of November at the earliest, however it is probable this feature was not present on completed vehicles until December. There are no known Panthers assembled by M.N.H. that were issued to units taking part in the Ardennes Offensive that have been identified with the new *Leiträder* fitted. Both M·A·N and M.N.H. would continue to fit the older 600mm diameter *Leiträder* (idler wheels) to a small number of the Panthers they completed into 1945.

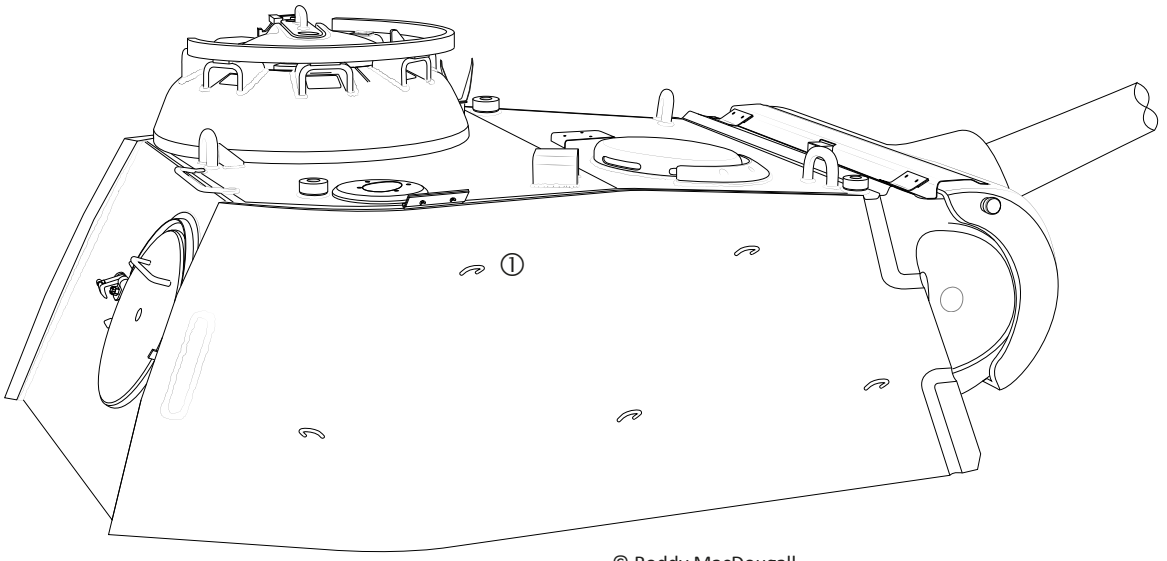
December 1944

The *Heeres-Waffenamt* instructed the assembly plants to modify the ventilator in the *Wanne* roof (drawing 43329 U5) on 1st December 1944. The current design allowed over pressure within the *Wanne* to be equalised by releasing air through pressure in the internal spring assembly, this needed to be modified to allow the vehicle to be positively pressurised. The *Fahrgestell* numbers of all Panther that had this modification were to be communicated to Abt.703. The instructions do not expand on the reason for this modification, however the emphasis placed on other modifications relating to gas filtration suggest this was to enable the vehicle to operate safely in a poison gas combat zone.

On 5th December the *Heeres-Waffenamt* were forced to send clarification of the confusing and sometimes contradictory sets of instructions issued in November regarding the installation of road wheel swing arms and *Anschlagböcke* (bump stops)

Production modifications to the *Ausführung* G *Türme*

①Towards the end of December both M·A·N and M.N.H. would start to fit five rings to the *Turm* sides to allow the attachment of foliage, this design change was never adopted on the *Ausführung* G Panthers completed by Daimler-Benz. Panthers with these rings that were assembled by both M·A·N and M.N.H. would be issued to I./Pz.Rgt. 39. ②The bracket welded to the *Turm* sides at the top of the rear plate interlock or carrying spare road wheels is unique to Panthers assembled by Daimler-Benz and was fitted to all of the Panthers completed by them from late December 1944 to the end of the war. ③A number of Panthers were fitted with the substantial rectangular steel plates for mounting the I.R. lamp on the gun mantle. The were designed to accept the special Bosch weatherproof connection plate and were welded permanently to the Panther's gun mantle. These were a relatively common feature on Panthers completed by all of the assembly plants from September 1944 on irrespective of whether or not the vehicle had any of the other modifications associated with I.R. equipment.



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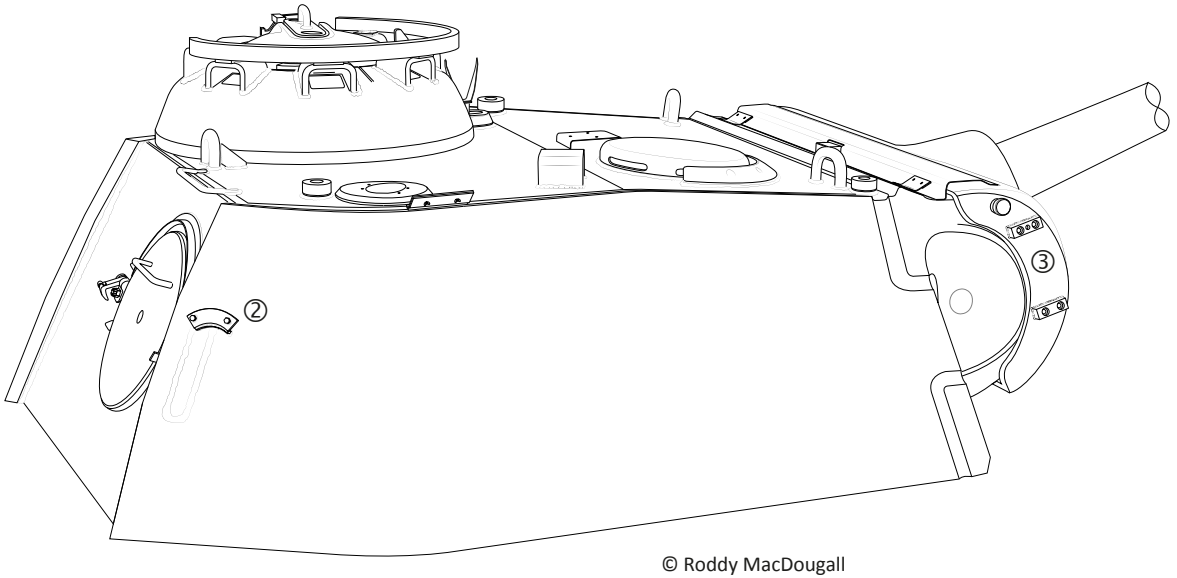

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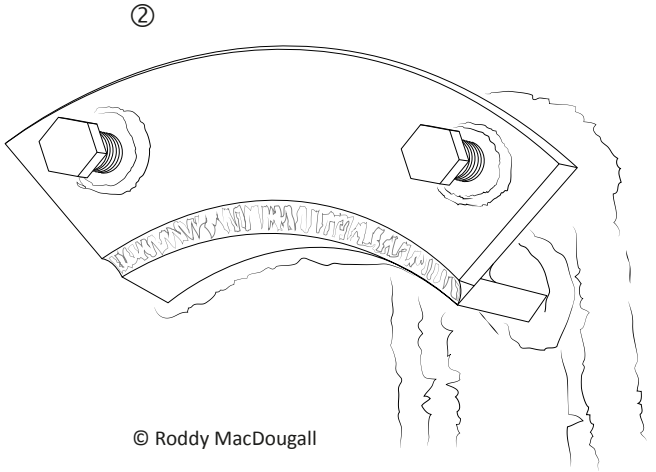

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that were to be fitted to Panther completed in December.

- 1st port and starboard swing arms: reinforced Siepmann swing arms 48393-40.
- 7th port and 8th starboard swing arm: reinforced Siepmann swing arm 48393-40
- Otherwise normal swing arms 48303-30.
- The front *Anschlagböcke* (bump stops) 48393 U5 were to be fitted over the 2nd port and starboard swing arms.The 4 rear *Anschlagböcke* (bump stops) 48393-4 together with 12 bolts 48393-19 and 18 Belleville washers 48303-69 were to be fitted over the 7th port and 8th starboard swing arm.

It would be early December before M.N.H. started fitting *Lost Erkennungstafeln* to the *Türme* of the Panthers it completed. The assembly plants would also start installing louvers over the starboard side rectangular armoured air intake grills to work in conjunction with the *Warmluftbeheizung*. M.N.H. was the first assembly plant to install these on Panther *Fgst.Nr.* 128877[29] completed on 9th December, M·A·N do not appear to have installed these louvers prior to this as Panther *Fgst.Nr.* 121298[30] completed by M·A·N around 7th December does not have these fitted. It would appear that Daimler-Benz may have already started to implement this design modification in November, Panther *Fgst.Nr.* 124932 was completed on or around 16th November 1944 and is currently fitted with the louvers. However, it was one of a significant number of Panthers at Aberdeen Proving Ground that were mechanically stripped down as part of their technical evaluation. There is a significant amount of evidence indicating that when these Panthers were being rebuilt they had components from vehicles that were mechanically unserviceable fitted to those of the same *Ausführung* that were in better mechanical condition. This was done in order to make these vehicles as complete as possible or in order to further evaluate the components on a running vehicle. It cannot therefore be ascertained that Panther *Fgst.Nr.* 124932 had the louvers fitted when it was completed as there is no known photograph showing the vehicles engine deck clearly while it was in transit or shortly after its arrival at the APG facilities that might confirm that the louvers were present prior to the technical evaluation.

M.N.H. were able to report on 8th December that they had started installing *Flammenvernichter* from Panther *Fgst.Nr.* 128875 (the 99th vehicle from order 60 0697) completed on 8th December. This was earlier than expected as additional supplies had been obtained on a special purchase contract due to the urgency that the *Heeres-Waffenamt* had placed on new vehicles being completed with these components. Interestingly these components are called *Flammenvernichter* (flame suppressors) in other documents but *Flammenverzehrer* (flame shredders) in the text of the document. There was nothing particularly unusual about this as multiple descriptions can be found between documents for what have been identified as the same components by the drawing numbers. Daimler-Benz started to fit *Flammenvernichter* around the end of November or beginning of December; Panthers assembled by Daimler-Benz with this design change were issued to I./Pz.Rgt. GD in late December 1944. These vehicles also have a bracket welded to the *Turm* sides at the top of the rear plate interlock for carrying spare road wheels. This feature is unique to Panthers assembled by Daimler-Benz and was fitted to all of the Panthers completed by them from early December 1944 to the end of the war[31].It is worth noting that the Panther *Schmalturm* for the *Ausführung* F recovered from Berlin at the end of the war has no ring for a *Fliegerbeschussgerät* on the cupola, five foliage loops welded on the *Turm* sides and the spare wheel bracket introduced by Daimler-Benz[32]. The Panthers issued to I./Pz.Rgt. GD are also the first Panthers from Daimler-Benz to have the port side *Balkenkreuz* applied to the *Fahrgestell* just behind the gun cleaning tools tube. There is no *Balkenkreuz* applied to the *Gepäckkasten*, it was moved to the middle of the rear *Fahrgestell* on these Panthers and was almost completely obscured by the vehicle's jack when this was stowed[33]. The starboard side *Balkenkreuz* typically remained between the two tool stowage brackets for the sledge hammer on some of these vehicles.

A new set of drawings and detailed instructions for installing the redesigned FG 1250 were issued to the assembly plants on 13th December. The drawing number for the mount indicates that this had been redesigned five times since the first sets of drawings were issued to the assembly plants. The *Wehrmacht*'s attempts to field combat ready Panthers equipped with FG 1250 night vision equipment are characterised by the issue of drawings and components that were then built into Panthers only to have some or all of the components stripped out of them prior to being issued to the troops. Following an enquiry from M.N.H. to the *Heeres-Waffenamt* regarding the production schedule for December they were informed on 14th December that there was no change to the revised figure of 30 Panthers prepared for use with FG 1250 equipment.

On 19th December M.N.H. reported to the *Heeres-Waffenamt* that the first transmissions fitted with a drive for the gas protection system had been delivered. It was foreseen that Panthers would be fitted with this gas protection system from order 60 098 onwards. It was therefore intended to install transmissions without a drive for the gas protection equipment on Panthers from order 60 097. Transmissions with the drive for gas protection equipment could only be installed after the plant's stock older transmissions were exhausted. They also noted that it would be necessary to check if the bridge 51148 U2 had the 4 holes drilled for mounting the gas protection aggregate, if not, the holes would need to be drilled at

29 Jentz and Doyle: *Panzer Tracts No.5-3 Panzerkampfwagen Panther Ausf. G.*

30 Panther *Fgst.Nr.* 121298 knocked out and photographed in the Fallingbostel area in April 1945.

31 There is the possibility that these brackets were used on a small number of Panthers assembled by M.A.N. employees working at Alkett. See page 260.

32 *Schmalturm* photographed at Aberdeen Proving Ground, Maryland U.S.A.

33 If further evidence were needed as to who applied the *Balkenkreuze* and when Panthers tools were issued at this stage of the war, this is a good example.

the assembly lines according to the accompanying drawing index 'c'. All the vehicles fitted with a transmission suitable for use with gas filtration system installed were to have their *Fahrgestell* numbers reported to Abt.703.

On 20th December the *Heeres-Waffenamt* sent a memo to the assembly plants regarding the use of *Dunkelgrün* RAL 6003 paint on the Panther's exterior. They refer to a previous memo on the subject dated 6th December and attached a list of exterior components that were to be given a coating of *Dunkelgrün* RAL 6003 paint along with an index of components that the sub contractors had been instructed by Abt.4111 to finish in *Dunkelgrün* RAL 6003 paint. The *Seitenvorgelege* (final drives) that M.N.H. supplied to other assembly plants were to be finished in the same *Dunkelgrün* RAL 6003 paint with immediately effect.

On 21st December the *Heeres-Waffenamt* wrote to the assembly firms regarding the *Jochdeckel* (bearing caps) 48303 U3 and 51103 U4 that covered the *Anschlagböcke* (bump stop) bearings in the *Wanne* sides. Following the deletion of the rear *Stoßdämpfer* (shock absorber) the split *Jochdeckel* 51103 U4 was only installed on one side. *Wannen* were still to be delivered from the armour manufacturers fitted with two piece split *Jochdeckel*. The single piece bearing caps 48303 U3 was not available in sufficient quantity and further supplies were not available. It was therefore arranged in consultation with the *Heeres-Abnahmestelle* that split bearings 51103 U4 are to be installed in the absence of sufficient stocks of the single piece bearings 48303 U3. Readers should note that the drawing numbers 51103 U4 covered the entire set of sub components for this detail so that the same number can be found referencing the *Anschlagböcke* (bump stop) as well as the bearing and bearing cover or cap. This was also the case for drawing number 48303 U3.

The *Heeres-Waffenamt* informed the assembly plants on 21st December that there was to be a change in the *Werkzeugkästen* (tool boxes) that had been simplified on the instructions of the *OKH*. These simplified tool boxes were issued a temporary drawing TuB 21062, and had been put into production. The existing stocks of *Werkzeugkästen* according to drawing 7641 were to be exhausted. According to a telex from M·A·N to the *Heeres-Waffenamt* dated 4th December the *Einsätze* (tool trays) would no longer be delivered.

OKH Wa Prüf 6 had informed the assembly plants on 11th December that the information stencilling on the Panther was not being uniformly applied. There were changes made to the stencilled markings that was required to be stencilled on equipment in the *Türme* of new Panthers.

On 23rd December the assembly plants were instructed to stencil "lose" and "fest" next to the *Turmzurrung* (Turret locking mechanism, drawing 021 St 50270) and "55 kg/cm² braun ark" on the *Vorholer* (gun recuperator mechanism, drawing 5 St 77009). The term "braun ark" refers to hydraulic fluid suitable for arctic conditions. The *Luftausgleicher* (air balancer mechanism) for the gun and mantle was also to be stencilled with either 75 bis 80 atü bei 0°" if the vehicle had the standard "round" gun mantle (021 St 50255) or "90 bis 95 atü bei 0°" if the new heavier strengthened "Chin" gun mantle (021 St 50258) was fitted. The assembly plants were instructed to pay particular attention to the type of gun mantle that was fitted before applying the *Luftausgleicher* (air balancer mechanism) stencilling. All other internal stencilling with the exception of those for the radio equipment was to be discontinued.

On 28th December M.N.H. reported to the *Heeres-Waffenamt* that they had been forced to install WJL 100 cylindrical roller bearings instead of *Tolzlager* 22220 (a specific type of roller bearing capable of absorbing loads in more than one direction) in the track tensioning mechanism due to a shortage of the correct roller bearings. There were 100 pieces of WJL 100 in stock at the plant that would be issued after the *Tolzlager* 22220 specified in drawing TuD 21585 had been exhausted. An alignment ring Tu 21585/1 is required during installation. The *Fahrgestell* numbers of the vehicles which have been equipped with the WJL 100 bearings were to be reported to Abt.703.

Photographic evidence confirms at some point in mid to late December M·A·N start completing Panthers with 800mm diameter steel tyred road wheels on the last station. Some of the first of these Panthers were issued in January 1945 to I./Pz.Rgt. 24, I./SS-Pz.Rgt. 1 and I./SS-Pz.Rgt. 12 who were refitting for operations in Hungary[34]. The problems experienced with obtaining adequate supplies of suitable suspension components are well documented. The deletion of the rear *Stoßdämpfer* (shock absorbers) presented something of a problem as they were considered necessary when the original design was conceived. The armour manufacturers were not issued with a revised design for the *Wanne* after the *Stoßdämpfer* was discontinued as it was hoped that a supply of this component could be found leading to their reintroduction. The addition of an extra 60mm of clearance from the standard 860mm diameter road wheel would alleviate some of the problems caused by the travel of the wheel forcing the tracks into the sponson floor while moving at speed over rough ground when the rear *Stoßdämpfer* (shock absorbers) was no longer fitted. M.N.H. would start to install an engine deck with fuel and water access ports that are the same diameter at the same time as a new design of engine deck ventilator fabricated from three flat plates. These components which are unique to M.N.H. assembled Panthers were fabricated by armour manufacturers who supplied them as a sub component. Throughout the production life of the Panther each of the assembly plants had idiosyncratic features that were unique to one plant and time frame where there is no surviving documentation to explain why a particular change or feature had been introduced at one particular assembly plant but not all.

Towards the end of December both M·A·N and M.N.H. would start to fit five rings to the *Turm* sides to allow the attachment of foliage; Panther Fgst.Nr. 121354 was completed by M·A·N on or around 25th December with these rings welded to the

34 These photographs are part of a private collection held by a historian.

turret sides[35]. This design change was never adopted by Daimler-Benz on the *Ausführung* G series. All three assembly plants would now fit a mixture of both the cast and welded exhaust armoured guards. On 20th December M.N.H. received a list of components to be base coated in *Dunkelgrün* RAL 6003; a camouflage pattern with sharp edges was to be applied over this with *Rotbraun* RAL 8017 and *Dunkelgelb* RAL 7028[36]. At some point in December 1944 or January 1945, Panthers were fully equipped with stowage, pioneer tools, fuel and ammunition prior to being shipped to the *Heereszeugämter*[37].

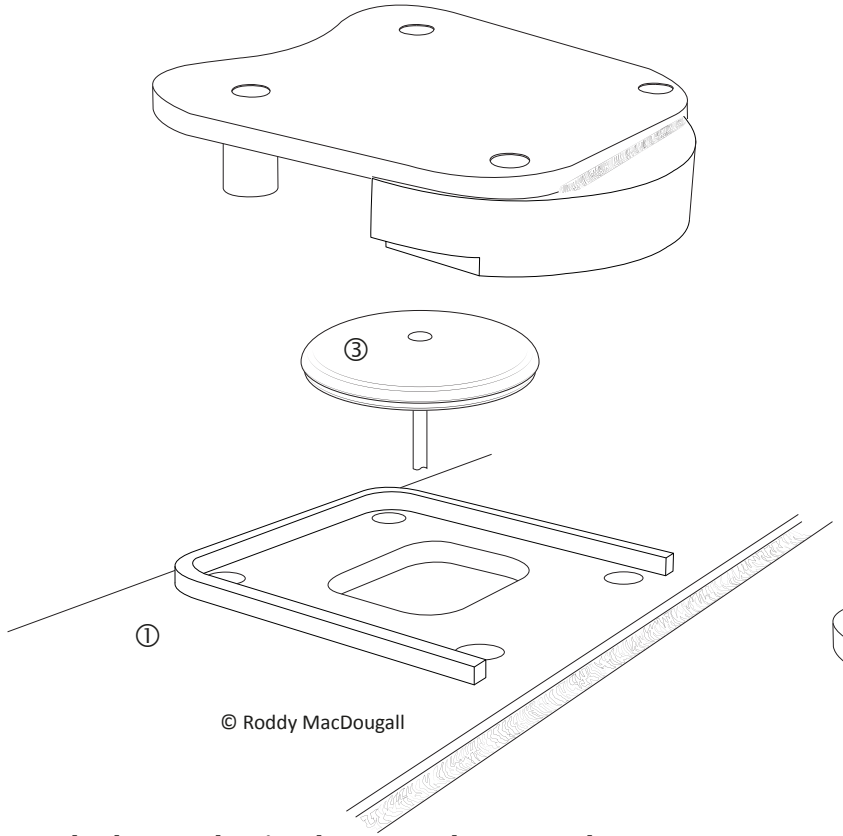
35 Darren Neely: Forgotten Archives Panzerwrecks

36 Jentz and Doyle: *Panzer Tracts No.5-3 Panzerkampfwagen Panther Ausf. G*. The colour shot of the Panther taken in Bad Kötzting, Bavaria in April 1945 confirms that M.N.H. completed Panthers with *Flammenvernichter* in December that were still finished in *Olivgrün* RAL 6003, *Dunkelgelb* RAL 7028 and a red brown colour that could be *Rotbraun* RAL 8017 or RAL 8012 primer. The Panther was issued to I./Pz.Rgt. 15, 11.Pz.Div. on 13th December 1944.

37 Allied interrogation of employees at M.N.H. following the German surrender and communication between M·A·N and the *Reichsministerium für Bewaffnung und Munition*.

Above:
This photograph of *Ausführung* G *Wannen* on the assembly line at the Daimler-Benz Werke 40 at Berlin, Marienfelde taken in September 1944 shows the original rectangular design for the armoured splasg guard and ventilator in the *Wanne* roof. The four items stacked on the *Wanne* roof ahead of the gang plank are the *Stoßdämpfer* (shock absorbers). The assembly plants were instructed to discontinue installing these in early October due to a shortage of this sub component. They can still be found on vehicles completed after this date as the existing stocks took some time to exhaust and the instruction to discontinue their use was driven by a lack of availability rather than this component becoming superflous. It is worth noting that the only assembly plant where Panther *Wannen/Fahrgestell* ran down the assembly lines side by side was at Daimler-Benz Werke 40. (Hartmann ZFNWP)

Wanne Ventilator Armour



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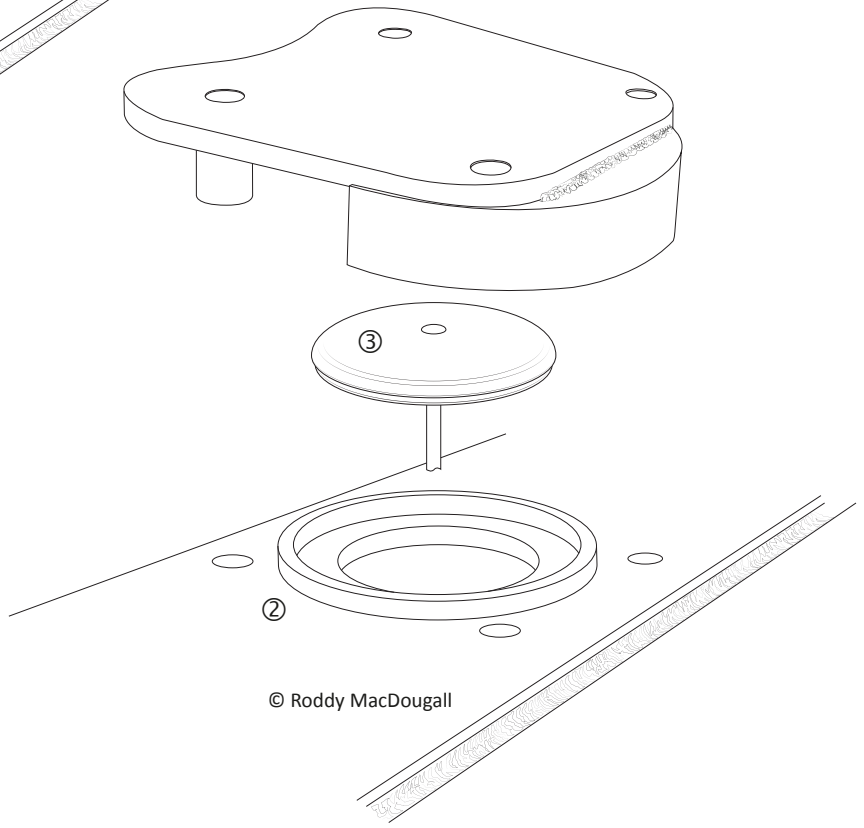

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The armour manufacturers had started to implement a change to the design of the bullet splash guard that surrounded the Wanne ventilator, ①the steel profile had previously been welded outside the ventilator armoured cap and was readily visible, the new design ②was circular and installed within the footprint of the armoured cover so that it is difficult to make out in period photos. Panthers with both patterns of splash guard were completed by Daimler-Benz in October 1944. The armour manufacturers would not all complete the change to the new splash guard design until December 1944; Daimler-Benz would still complete some Panthers in November and December with the original square design. ③A *Belüftungspilz* (Domed air intake cover) regulated the flow of air and could be used to halt air flow through the ventilator. The *Belüftungspilz* (Domed air intake cover) was not fitted to a number of *Ausführung* G Panthers completed by M.N.H, see pages 138 & 239.

FACTORY APPLIED CAMOUFLAGE PATTERN COLOUR PROFILES

M·A·N Main Profile Overview

	Fahrgestell Number	Time frame	Page
M·A·N Panther Ausf. G		August 1944	175
M·A·N Panther Ausf. G.	Fgst.Nr. 121020	September 1944	178
M·A·N Panther Ausf. G.	Fgst.Nr. 121052	September 1944	180
M·A·N Panther Ausf. G.	Fgst.Nr. 121080	September 1944	188
M·A·N Panther Ausf. G.		September 1944	192
M·A·N Panther Ausf. G	Fgst.Nr. 121146	October 1944	194
M·A·N Panther Ausf. G.	Fgst.Nr. 121190	October 1944	198
M·A·N Panther Ausf. G	Fgst.Nr. 121264	November 1944	202
M·A·N Panther Ausf. G.	Fgst.Nr. 121280	December 1944	205
M·A·N Panther Ausf. G	Fgst.Nr. 121306	December 1944	210

Daimler-Benz Profile Overview

	Fahrgestell Number	Time frame	Page
Daimler-Benz Panther Ausf. G		September 1944	212
Daimler-Benz Panther Ausf. G	Fgst.Nr. 124830	October 1944	218
Daimler-Benz Panther Ausf. G		November 1944	222
Daimler-Benz Panther Ausf. G		December 1944	226

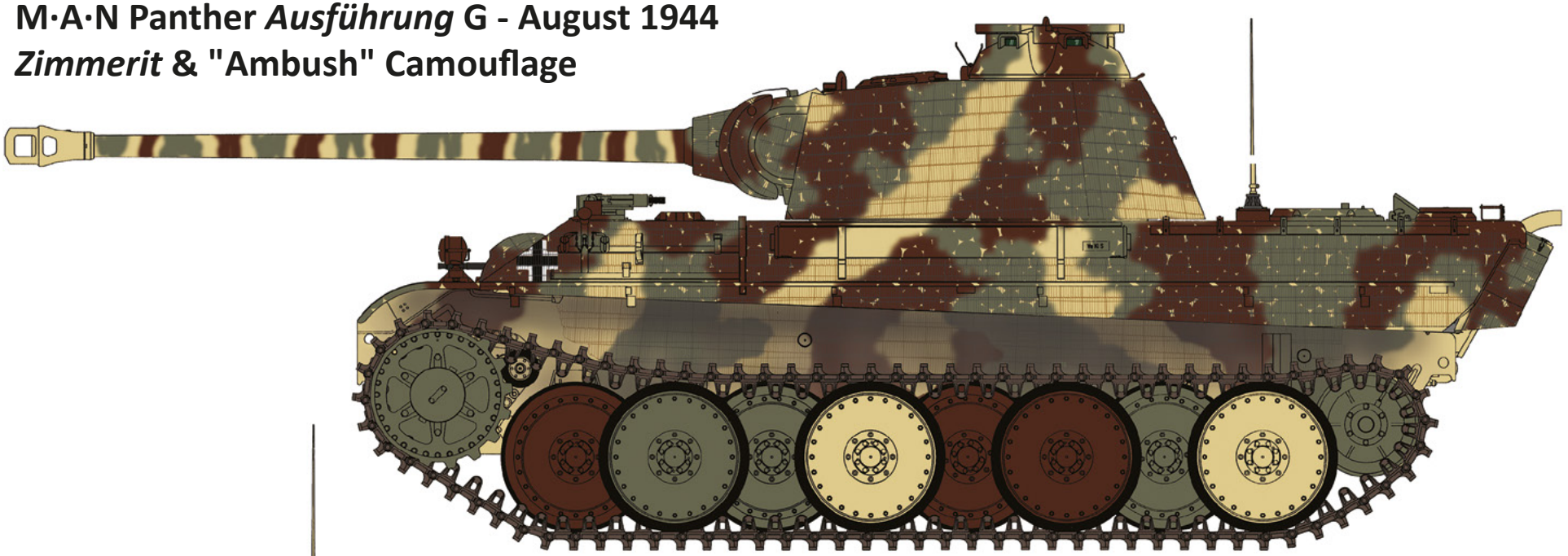
M.N.H. Profile Overview

	Fahrgestell Number	Time frame	Page
M.N.H. Panther Ausf. G		August 1944	229
M.N.H. Panther Ausf. G		September 1944	236
M.N.H. Panther Ausf. G		September 1944	240
M.N.H. Panther Ausf. G		October 1944	244
M.N.H. Panther Ausf. G	Fgst.Nr. 128777	November 1944	247
M.N.H. Panther Ausf. G		Late November 1944	252
M.N.H Panther Ausf. G	"Chevron"	November 1944 on	255

M·A·N FACTORY APPLIED CAMOUFLAGE PATTERNS

One of several Panthers completed by the M·A·N plant in Nürnberg in the "Disc" scheme at the end of August and issued to I./Pz.Rgt. 16 between 3rd and 6th September 1944. This is one of series of photographs showing Panthers from this unit while it was attached to Pz.Brig.111 in and around Bures in the Lorraine region of France on 20th September 1944. We can see that large areas on these Panthers are covered in *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003. A prominent feature on these Panthers is the application of a "Disc" camouflage overlay in *Dunkelgelb* RAL 7028 which made up the "Ambush" element of this pattern. There is no loss of opacity, fading or apparent absorption of the paint on the surfaces coated with *Zimmerit*, the *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 colour fields on surfaces with a coating of *Zimmerit* paste show similar properties to those on armour components that are devoid of this coating such as the commander's cupola and Turm roof components. (Bundesarchiv 101I-301-1955-32, KB Kurth)

M·A·N Panther *Ausführung* G - August 1944
Zimmerit & "Ambush" Camouflage



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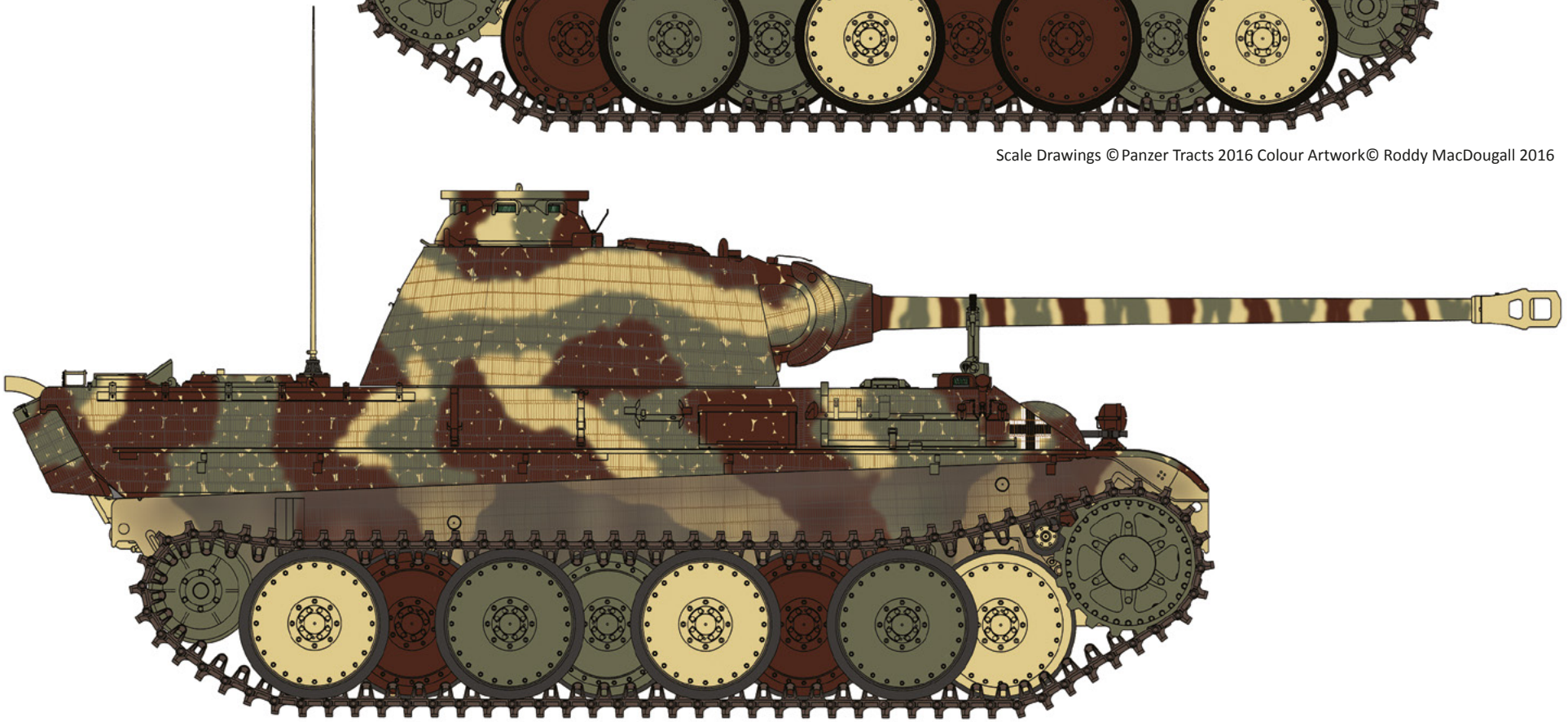

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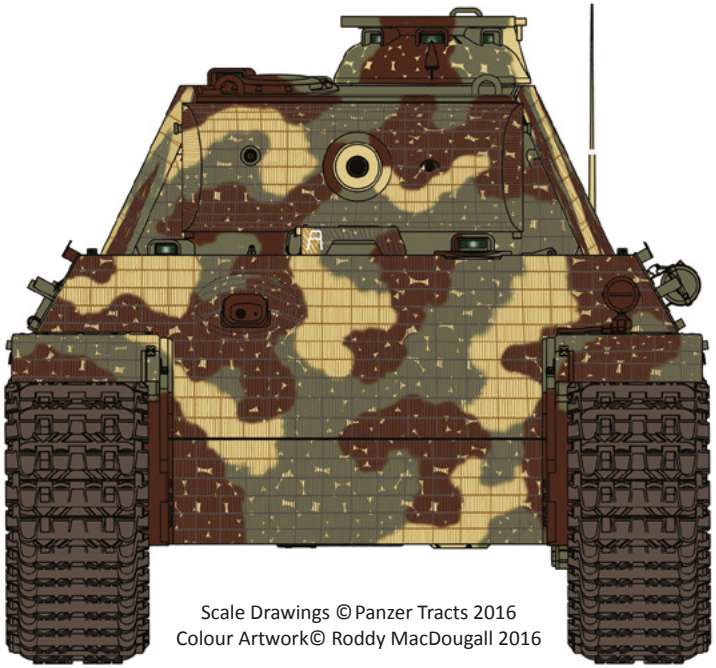

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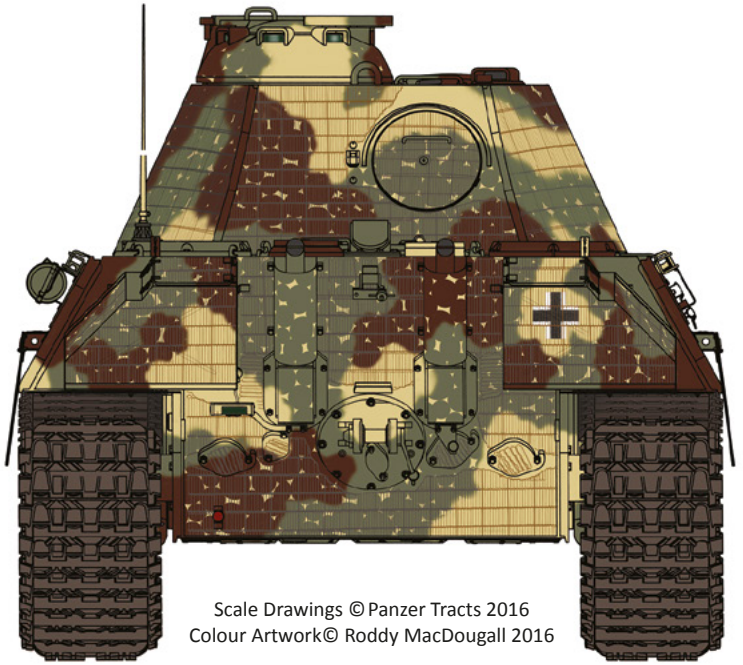

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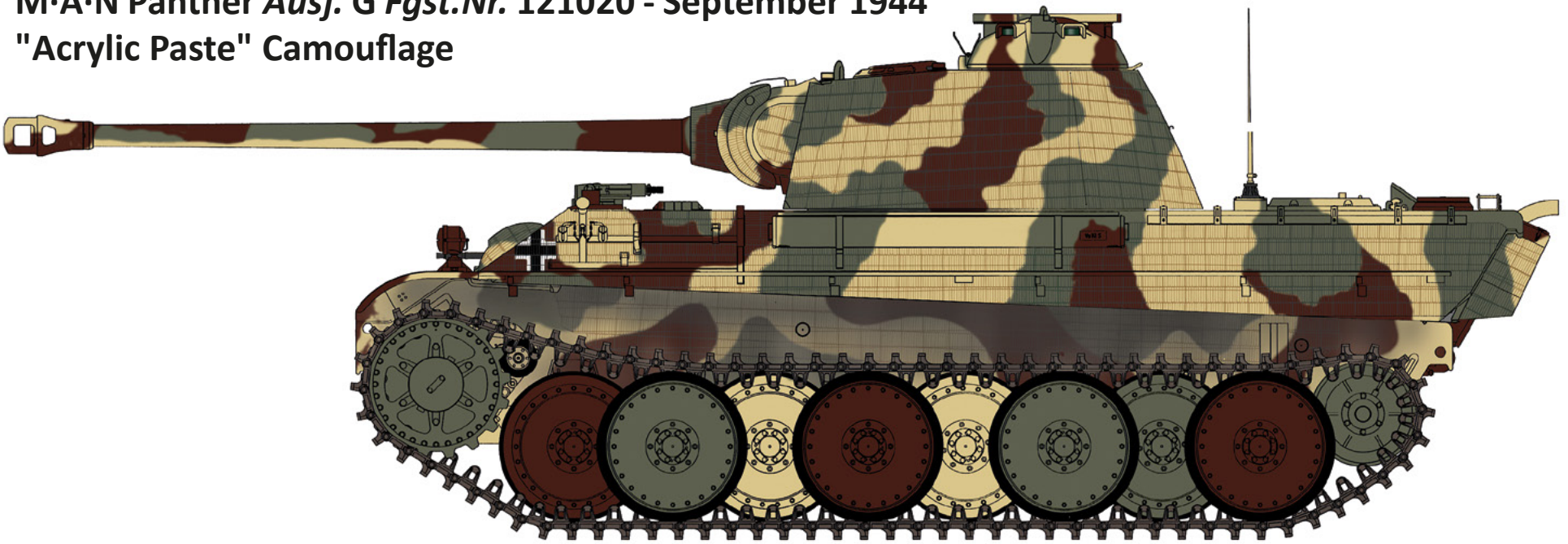
The development of standardised camouflage patterns saw factory applied camouflage schemes officially introduced on 19th August 1944. Instructions were issued to the assembly firms to apply the camouflage pattern at the assembly plant with *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 spray painted in patches over the *Dunkelgelb* RAL 7028 base coat. This order created the camouflage pattern which has become widely known as the "Ambush" or "*Licht und Schatten*" camouflage scheme. We can see how this order was implemented by M·A·N after the 19th August in this example of a Panther from I./Pz.Rgt. 16 that was present in a sequence of photographs and cine film showing Panthers from this unit while it was attached to Pz.Brig. 111 at Bures in the Lorraine region on 20th September 1944. We can see that large areas on these Panthers are covered in *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003. A prominent feature on these Panthers is the application of a "Disc" camouflage overlay in *Dunkelgelb* RAL 7028 which made up the "Ambush" element of this pattern. This was applied using a stencil mask made up with different sizes of discs (there were typically 3 sizes used to make each stencil) connected together at the edges. These were arranged so that the left and right hand sides of the pattern could interlock which resulted in a repeating pattern that looked as though it had been applied with a roller or the repeating pattern on wallpaper. There were clearly instructions on how to create the stencils issued to the assembly firms, it is worth noting that there are several minor variations to the size and placement of the discs used to create the stencils so that subtle differences can be seen on different vehicles completed by either M.N.H. and M·A·N. The stencil was not always aligned on the vehicle during the painting process resulting in some vehicles with this pattern leaving the assembly plant with overlapping or poorly aligned overlays. The mask itself was flexible enough to conform to the radius of the gun cleaning tools stowage tube and the sheet metal guards fitted over the exhaust stacks. The scheme was finished by randomly spraying meandering bands of *Dunkelgelb* RAL 7028 over the previous coats of paint. The textured finish on the *Zimmerit* anti magnetic paste and the location of the *Balkenkreuze* national markings can be used to determine whether M.N.H. or M·A·N assembled any particular Panther painted in this new camouflage scheme. The Panthers were covered with a thick layer of foliage so there are no Fahrgestell numbers visible on any of the Panthers. The *Balkenkreuze* national markings were applied to the *Fahrgestell* sides ahead of the tool stowage brackets and on the starboard side *Gepäckkasten* on the *Fahrgestell* rear. The gun barrel was camouflaged with alternating bands of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 spray painted over the *Dunkelgelb* RAL 7028 heat resistant lacquer.

M·A·N Panther *Ausf.* G *Fgst.Nr.* 121020 - September 1944 "Acrylic Paste" Camouflage



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The Panthers completed by M·A·N between the end of August and 16th/17th September 1944 were completed in a camouflage scheme that is significantly different in appearance to either the "Disc" camouflage scheme used before they were built or the camouflage schemes used from 17th/18th September on to the end of series production. We cannot determine with certainty if M·A·N completed these Panthers in an overall coat of *Dunkelgelb* RAL 7028 and they were then subsequently issued to their units with tins of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 acrylic paste concentrate to allow the units to camouflage them in accordance with guidelines or specific instruction. This does seem to be an extremely remote possibility but one that cannot be dismissed completely. It is more credible that these Panthers were completed in a new camouflage scheme that is devoid of any "Ambush" or "*Licht und Schatten*" element applied at the M·A·N assembly plant using paint with significantly different characteristics to the paint used on the "Disc" camouflaged Panthers completed earlier. The *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 elements of this later scheme are either quickly absorbed into the *Zimmerit* paste or fade rapidly on the areas of the vehicle coated with *Zimmerit* but retain their colour fastness on the metal surfaces of the vehicle. It is possible that acrylic paste was used for these two colours rather than the urethane synthetic resin paints used for the "Disc" camouflage schemes which were more colour fast. There is some consistency in the size, location and appearance of the colour fields on these vehicles that can be seen on Panthers issued to different units that is an attribute of factory applied camouflage schemes. Two of these ex I./Pz.Rgt. 24 Panthers were knocked out in Hotton, Belgium during the Ardennes Offensive. The vehicle depicted in this colour plate was knocked out on the Rue Haute and is visible in several photographs. Its *Fahrgestell* number 121020 confirms that it was completed on or about 15th September 1944. For whatever reason M·A·N would either stop applying a factory applied camouflage scheme or use paints for a new scheme that have considerably different properties on the Panthers they completed for a period that is probably little more than two weeks between the end of August and the 16th/17th September 1944. M·A·N would recommence applying a factory applied camouflage scheme with more familiar characteristics no more than three days after Panther Fgst.Nr. 121020 was completed, Panther *Fgst.Nr.* 121032 was completed by M·A·N with a factory applied camouflage scheme on or about 18th September. With only two exceptions, the colour plates in this publication illustrate the camouflage schemes and markings present on the vehicles depicted when they left their respective assembly plants. Panther *Fgst.Nr.* 121020 is depicted as it would have looked with a factory applied camouflage scheme applied using acrylic paste for the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 colour fields prior to any absorption of this media into the Zimmerit paste.

Panther *Fgtst.Nr.* 121020 completed by M·A·N on or around 15th September and painted in a standardised factory applied camouflage scheme at the M·A·N plant in Nürnberg. The colour fields have considerably different properties to those on Panther *Fgst.Nr.* 121046 on pages 194-196, and *Pz.Bef.Wg.* Panther *Fgst.Nr.* 121080 on pages 188-190. The colour fields on the *Zimmerit* paste visible in this photograph of Panther *Fgst.Nr.* 121020 should be compared to those on *Pz.Bef.Wg.* Panther *Fgst. Nr.* 121080, even making allowances for varying light conditions there can be little doubt that the paints used on the Panthers completed in early September do not have the same properties as those used for standardised camouflage schemes at the M·A·N in August or from around 16th/17th September on to the end of the war. This change in materials is limited to Panthers completed at the M·A·N plant in Nürnberg and is not apparent on vehicles completed by either Daimler-Benz or M.N.H. from 19th August on to the end of the war. (Robert Demelenne via Jean-Michel Delvaux)

M·A·N Panther *Ausf.* G *gummigefederte Stahllaufrollen*
Fgst.Nr. 121052 September 1944

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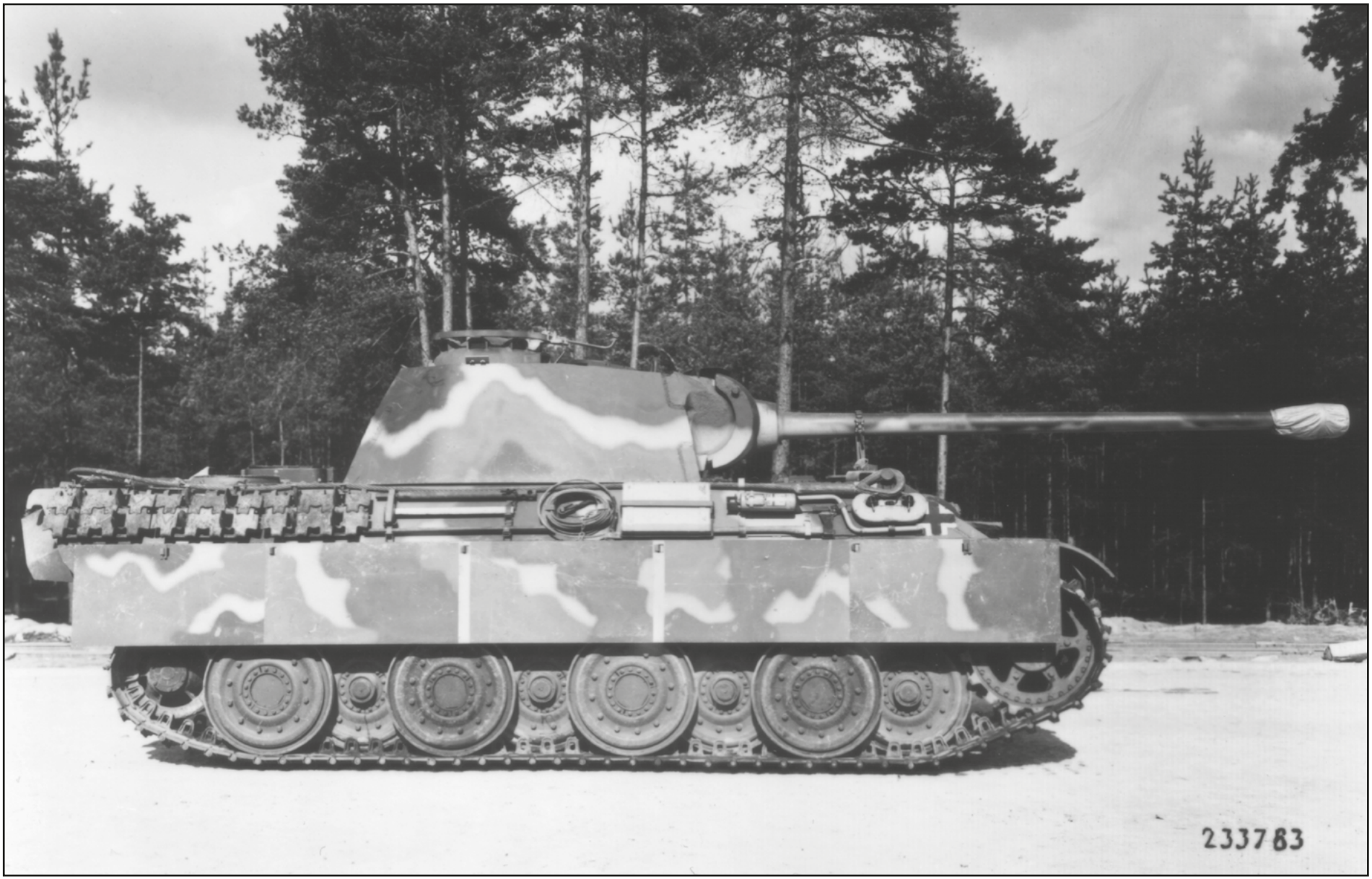
A small run of Panthers assembled by M·A·N were used to trial *gummigefederte Stahllaufrollen* steel tyred road wheels with internal rubber cushioning. This wheel had been successfully used in the Tiger I *Ausf.* E and Tiger II *Ausf.* B; it was fitted with a new hub to allow it to be used for the Panther trial that was intended to test its suitability for series production. The earliest recorded *Fgst.Nr.* from this trial run is Panther *Fgst.Nr.* 121032 and the latest is Panther *Fgst.Nr.* 121055, by coincidence both of these Panthers were amongst the group of 6 vehicles fitted with *gummigefederte Stahllaufrollen* issued to 2./SS-Pz.Rgt. 1 that were subsequently lost in the Ardennes Offensive. M·A·N would commence fitting *Warmluftbeheizung* to the Panthers it completed part way through the trial run fitted with *gummigefederte Stahllaufrollen*. The earliest vehicle fitted with a *Warmluftbeheizung* completed by M·A·N is from this group of vehicles fitted with *gummigefederte Stahllaufrollen* recorded to date is Panther *Fgst.Nr.* 121032 completed on or about 21st September 1944. The *Warmluftbeheizung* is unusual in that it is one of the very rare instances where a design modification was introduced to series production and a small number of the following vehicles in the production schedule from the same assembly plant were completed without it. The colour fields used in the standardised factory camouflage scheme applied to the *gummigefederte Stahllaufrollen* Panthers that were completed in mid September have a familial similarity to the main colour fields on the Panthers completed in the "Disc" scheme at the end of August and issued to I./Pz.Rgt. 16 illustrated on pages 176-177. This is particularly noticeable when comparing the horizontal band of *Dunkelgelb* RAL 7028 that separates the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 on the *Türme* of several of the "Disc" camouflage vehicles filmed with I./Pz.Rgt. 16 around Bures and the *gummigefederte Stahllaufrollen* Panthers *Fgst. Nr.* 121032 (tactical number 201) and *Fgst.Nr.* 121052 (tactical number 231) issued to 2./SS-Pz.Rgt. 1. M·A·N would recommence applying a factory applied camouflage scheme using paints with more familiar characteristics than those used on Panther *Fgst.Nr.* 121020 completed three days earlier. Panther *Fgst.Nr.* 121032 was completed by M·A·N with a factory applied camouflage scheme using the more robust urethane alkyd resin paints on or about 18th September. A comparison should be made of the paint properties evident in period photographs showing Panther *Fgst.Nr.* 121020 on pages 164-165, Panther *Fgst.Nr.* 121046 on pages 194-196, Panther *Fgst.Nr.* 121052 as illustrated here on pages and *Pz.Bef.Wg.* Panther *Fgst.Nr.* 121080, particularly the vertical armour surfaces on the *Turm* on pages 188-190. We will use the *Dunkelgelb* RAL 7028 colour fields as examples when discussing the detail changes mentioned in the majority of profiles and photographs throughout this book because they show the biggest contrast and are easier to see in period black and white photographs.

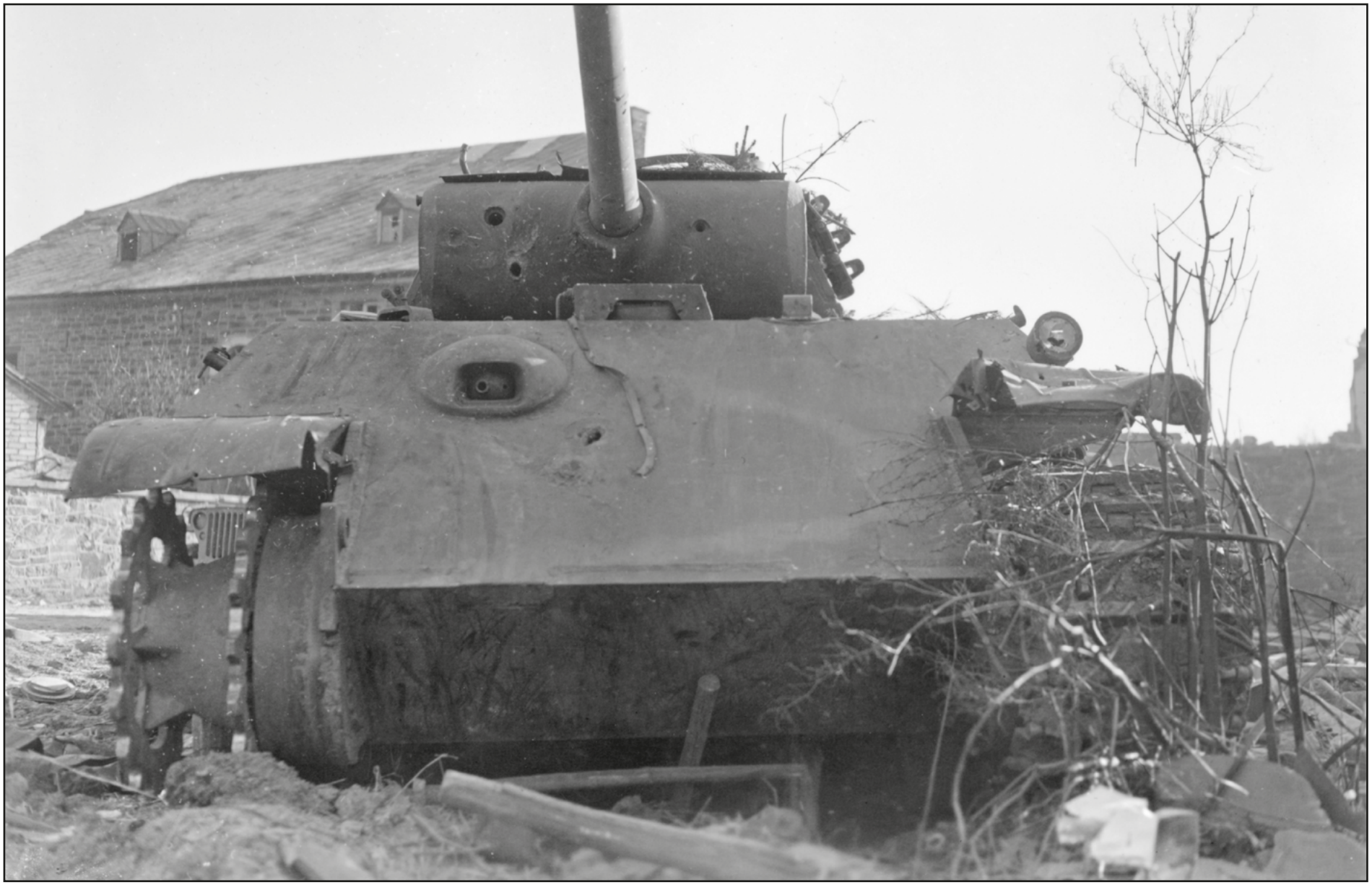
A small run of Panthers assembled by M·A·N in September 1944 were used to trial *gummigefederte Stahllaufrollen* steel tyred road wheels with internal rubber cushioning. The earliest Panther fitted with these wheels identified so far was completed on or around 18th September 1944. It was painted using urethane synthetic resin paints which have properties that are quite different to those paints used on the Panthers completed by M·A·N earlier in September. The original photograph reveals that the gun cleaning tools tube on Panther *Fgst.Nr.* 121052 has "Fu 5 + 2 KK" marked on it, indicating this Panther has been fitted out as a company or platoon commander's vehicle. M·A·N would start to fit the *Warmluftbeheizung* (warm air heater, drawing 51123) or, as it has since become known, the *Warmluftbeheizung* (crew compartment heater) during the trial run of Panthers equipped with *gummigefederte Stahllaufrollen* steel tyred road wheels in September 1944. This would be standard equipment on all *Ausführung* G Panthers from October on (Johann Buchner M·A·N)



Panther *Fgst.Nr.* 121052 was finished in a factory applied camouflage scheme that consisted of an overall coat of *Dunkelgelb* RAL 7028; large distinct colour fields were then applied over this using *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 which covered 70-80% of the *Dunkelgelb* RAL 7028 base coat. Following the introduction of factory applied camouflage the *Schürzen* were painted using the templates supplied for these in the camouflage scheme then in use as a complete set for one side of the vehicle. The sets were not matched to a particular vehicle and as we can see in this photo, the crew did not always hang the plates in the correct order or use all the plates painted for one side. This Panther was issued to I./SS-Pz.Rgt. 1 from 1.SS-Pz.Div. LAH in October 1944 and was photographed when it was in the process of being handed over to this unit at Grafenwöhr *Heereszeugamt* in October 1944. (Johann Buchner M·A·N)

This Panther has its *Fgst.Nr.* 121052 stencilled on the glacis and has the white flat topped "A" applied to the vertical front face of the gun travel lock after passing its Abnahmestelle inspection. The last two digits of the *Fahrgestell* number have been painted on the hinged section of the front fenders as was the practice at M·A·N. The *Balkenkreuze* national markings have been applied following which this Panther was shipped to the *Heereszeugamt* at Grafenwöhr. The *Dunkelgelb* RAL 7028 counter shading on the bottom of the gun barrel is typical of Panthers completed by M·A·N, another feature of post September 1944 Panthers completed by M·A·N was a *Dunkelgelb* RAL 7028 muzzle brake. (Johann Buchner M·A·N)

There was a sprung sheet metal tab on the locking bolt for the loader's hatch of Panther *Fgst.Nr.* 121052. The *Turm* shows areas of exposed *Dunkelgelb* RAL 7028 around the lifting point on the front starboard side and the paint coverage on the rear quarter is not consistent with the *Dunkelgelb* RAL 7028 base coat showing through the *Rotbraun* RAL 8017 camouflage field. This *Turm* was manufactured by Eisenwerke Oberdonau (kmy) who cut the rear edges of the side armour parallel with the rear armour plate, this armour manufacturer did not fit the forged ventilator armoured cover. This was one of a number of *Türme* delivered to M·A·N and M.N.H. in August and September 1944 without *Pilze* sockets on the roof. (Johann Buchner M·A·N)

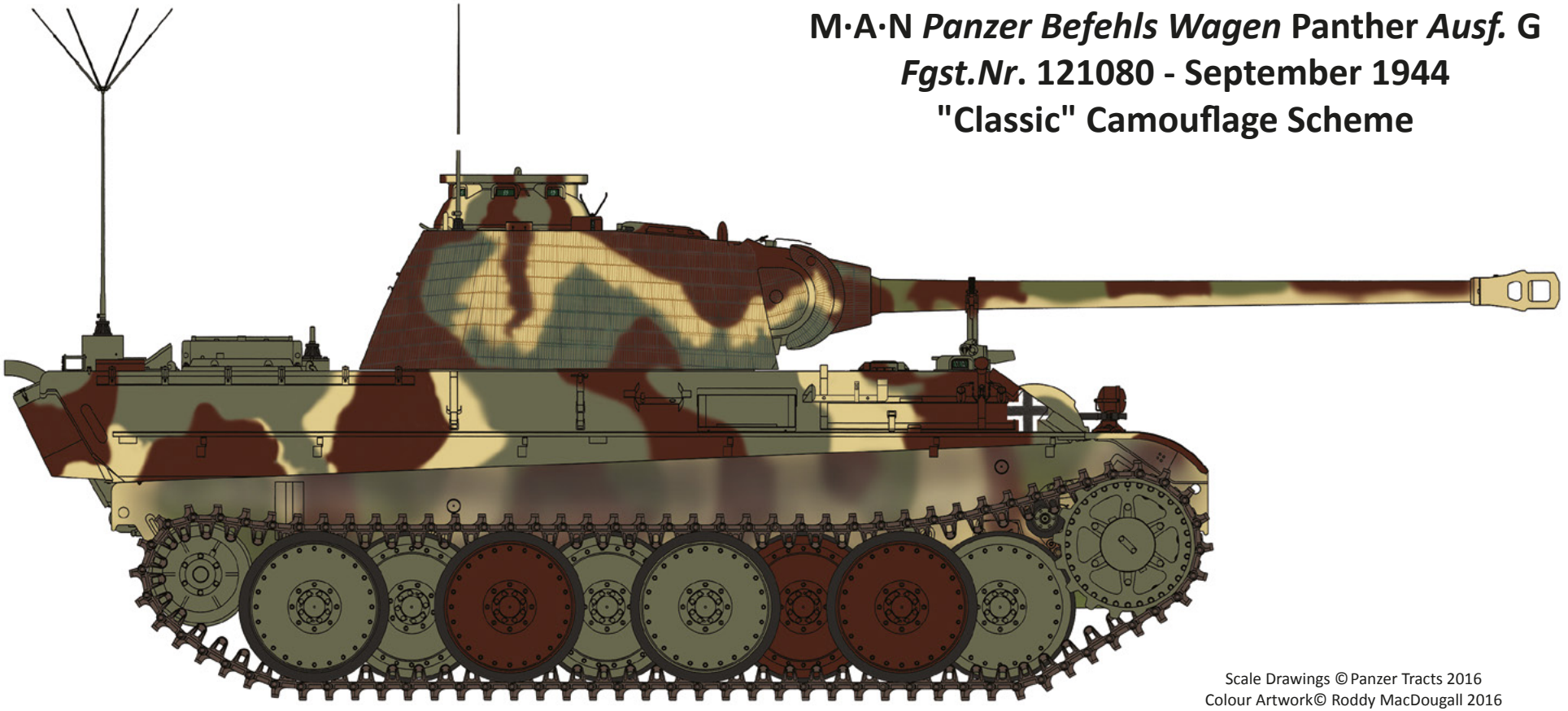


One of the 6 Panthers assembled by M·A·N in September 1944 that was fitted with *gummigefederte Stahllaufrollen* (steel tyred road wheels) that were issued to 2./SS-Pz. Rgt. 1. was Panther tactical number 221. This Panther was issued to the *Hscha.* Heinz Knappich who commanded the vehicle during the Ardennes offensive where it was ultimately abandoned in the village of La Gleize. It was examined by U.S. Forces following the recapture of the town who noted that there were several Panthers in the vicinity of the village fitted with non standard road wheels. The *Fahrgestell* numbers of these Panthers were noted along with the 3 letter manufacturers identification code "bnd". This Panther can be identified by its distinctive camouflage pattern in the distance behind Panther *Fgst.Nr.* 121052 on the photograph shown on the previous page. It has the distinctive white flat topped letter "A" applied following its acceptance by the *Heeres-Abnahmestelle* inspectors at the M·A·N plant in Nürnberg. Although not visible in this photograph this Panther has the *Fahrgestell* number 121046 or 121055 (see page 158). This Panther was not fitted with a *Warmluftbeheizung* (warm

air heater, drawing 51123) despite some of the earlier vehicles in the *gummigefederte Stahllaufrollen* (steel tyred road wheels) production run having these fitted. A spare *gummigefederte Stahllaufrollen* steel tyred road wheel was mounted on the engine deck and other photographs show a second spare wheel mounted on the *Turm* roof prior to its destruction by personnel from the U.S. 105th Engineer Battalion. It was during the production run between 21st and 22nd of September 1944 that the first Panthers completed with the "Classic" factory applied camouflage scheme were completed with Panthers *Fgst.Nr.* 121051 and *Fgst.Nr.* 121039 both being finished in the new scheme. The camouflage applied to earlier vehicles as well as a number of other Panthers in this trial run have some loose similarity to each other as well as roughly the same precentage of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 which covered 70-80% of the *Dunkelgelb* RAL 7028 base coat. This colour percentage is similar to that used on Panthers with the "Classic" factory applied camouflage scheme. (1 x NARA via Darren Neely. 1 x Darren Gawle & Roddy MacDougall)

***Pz.Bef.Wg.* Panther *Fgst.Nr.* 121080 was completed by M·A·N on or around 28th September and was finished in the *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 standardised "Classic" factory applied camouflage scheme that had just been introduced at the M·A·N plant. The *Turm* has a coating of *Zimmerit* paste on the vertical armour plate surfaces, some of this has spalled off the armour plate after the vehicle was hit by fire from a U.S. M4 Sherman that triggered an internal explosion. The shape of the *Rotbraun* RAL 8017 colour field on the upper front corner is typical of M·A·N Panthers painted in the "Classic" camouflage scheme. The *Balkenkreuze* national markings are painted on the front corners of the *Fahrgestell* just ahead of the tool stowage brackets. The roughly painted flat topped "A" applied to M·A·N vehicles indicating their acceptance by the *Heeres-Abnahmestelle* inspectors can be made out on the gun travel lock and the vehicle's *Fahrgestell* number has been stencilled on the glacis plate underneath the *Kugelblende*. (Haasler, MacDougall, Thomson & Vosters)**

M·A·N *Panzer Befehls Wagen* Panther *Ausf.* G *Fgst.Nr.* 121080 - September 1944 "Classic" Camouflage Scheme



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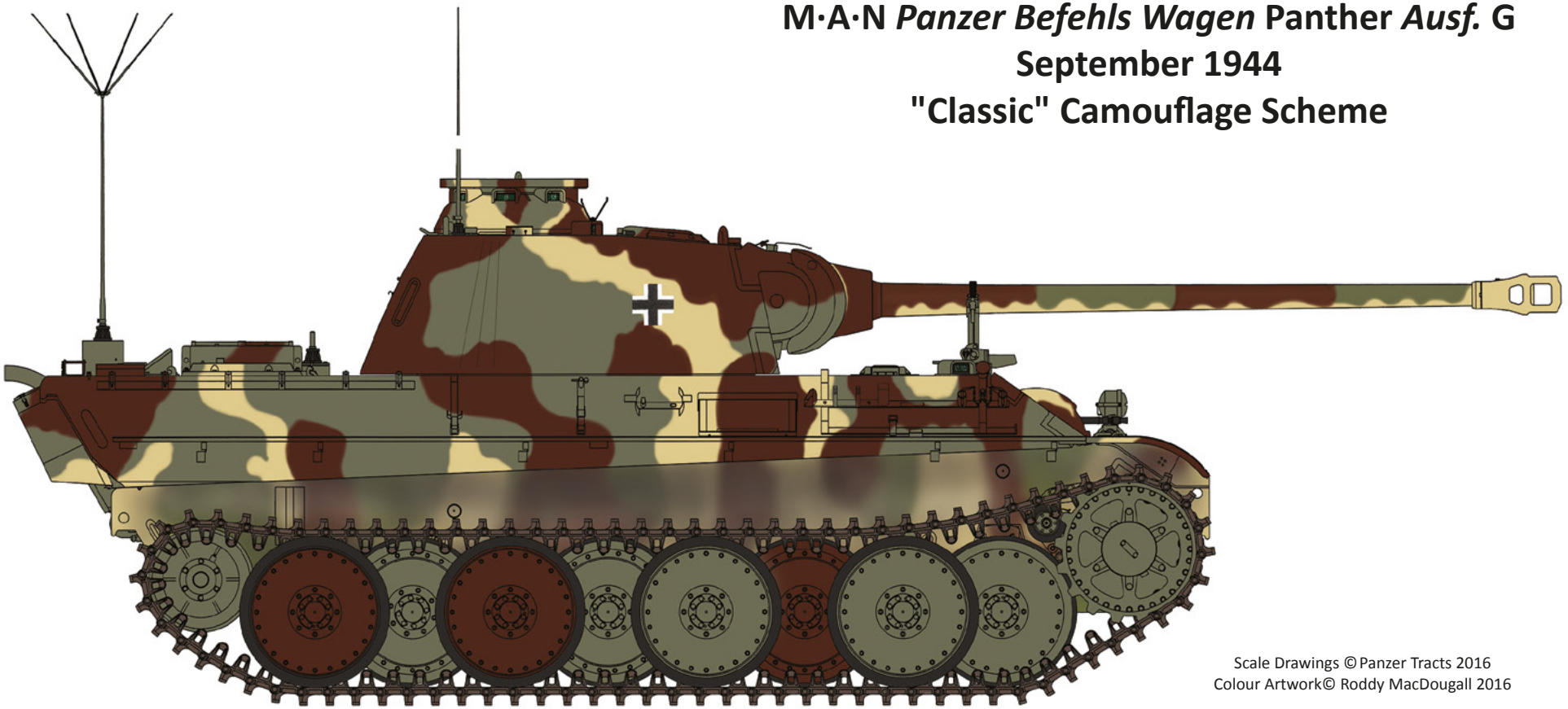
M·A·N were contracted to complete a number of Panthers each month as *Panzer Befehls Wagen*. The design changes necessary to assemble a *Pz.Bef. Wg.* Panther are outlined in chapter 4. The *Türme* would receive a coating of Zimmerit paste early on in the assembly sequence as a sub component which would be completed and tested separately before being mounted on the mechanically complete *Wannen* which were known as *Fahrgestell*. As a result of the changes made to the design and components used to assemble the *Turm* for a *Pz.Bef.Wg.* Panther, these would take longer to complete than a standard Panther *Turm* resulting in a small number of *Pz.Bef.Wg.* being completed with a coating of *Zimmerit* paste on the Türme but not the *Fahrgestell* at the end of September 1944. Panther *Fgst. Nr.* 121080 was issued to Stab I./SS-Pz.Rgt. 1 and was one of at least two of these *Pz.Bef.Wg.* Panthers with a *Zimmerit* coating on their *Türme* issued to units that took part in the Ardennes Offensive in December 1944. The *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 colour fields on the surfaces that are coated with *Zimmerit* paste have noticeably different properties to those on the Panthers completed a earlier in September. The *Dunkelgelb* RAL 7028 counter shading on the 7.5cm Kw.K.42 L/70 main gun that is typically of Panthers assembled by M·A·N up to January 1945. It can be found on all of the known Panthers finished in the "Classic" standardised factory applied camouflage scheme completed by M·A·N. The muzzle brake assembly on these Panthers appears to have been masked as it is always *Dunkelgelb* RAL 7028. There are two combinations used for the *Balkenkreuze* national markings applied to *Pz.Bef.Wg.* Panthers. The Ausführung G Panthers assembled by M·A·N had the *Balkenkreuze* applied to the front corners of the Fahrgestell just ahead of the tool stowage brackets on both the port and starboard side, the location of the rear *Balkenkreuz* was the starboard side *Gepäckkasten* (stowage bin). This standard combination was also used on *Ausführung* G *Pz.Bef.Wg*. Panthers. A significant number of Pz.Bef. Wg. Panthers had an alternative placement where the *Balkenkreuze* were only applied to the *Türme* sides with the rear plate bereft of this marking. This alternative *Balkenkeuze* arrangement is only found on *Pz.Bef.Wg.* Panthers but not *Sd.Kfz.* 171 Panthers completed by M·A·N. It does not appear to have been driven by the time frame of a vehicles assembly with both combinations appearing in 1944 to early 1945. The *Heereszeugamter* had no influence on these marking combination as *Pz.Bef.Wg.* Panthers with both combinations of *Balkenreuze* arrangements were **(Continued page 192)**

This photograph of *Pz.Bef.Wg.* Panther *Fgst.Nr.* 121080 illustrates the difficulty in identifying the shape and location of the *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 colour fields that made up the standardised "Classic" factory applied camouflage scheme. Different light conditions affect the amount of light reflection which can alter the appearance of the colour fields on black and white photographs. The *Olivgrün* RAL 6003 is particularly susceptible to varying light conditions as is evident in the two photographs of Panther *Fgst.Nr.* 121080. We are fortunate that there are numerous photographs of almost all of the individual Panthers illustrated in this book allowing us to compare the colour fields and unsure the accuracy of the colour profiles. The remants of the roughly painted flat topped "A" applied to M·A·N vehicles indicating their acceptance by the *Heeres-Abnahmestelle* inspectors can also be made out on the vehicles gun travel lock in this photograph. The *Pz.Bef. Wg.* Panther *Fgst.Nr.* 121081 completed by M·A·N on the same day in September 1944 did not have any *Zimmerit* coating or the white "A" present when it was extensively photographed for propoganda purposes in the late Autumn of 1944. It does however have its *Balkenkreuze* national markings painted on the front corners of the *Fahrgestell* just ahead of the tool stowage brackets, its *Fahrgestell* number and a "G" painted in black on the glacis plate. The "G" marking on the glacis indicated to the vehicles crew and *Werstatt* personnel that its motor coolant was treated with *Glysantin*. (Dieter Laes)

This *Pz.Bef.Wg.* Panther from II./Pz.Rgt. 33 is the same vehicle shown on page 61 that was knocked out or abandoned in Wilwerdange, Luxembourg at the end of the Ardennes Offensive. It was completed in September 1944 and was painted in the "Classic" factory camouflage scheme at the M·A·N assembly plant which can be seen in the photograph taken in summer 1945. The gun mantle is the intermediate strengthened pattern fitted to a significant number of Pz.Bef.Wg. Panthers from the end of August until it was superseded by the new strengthened " Chin" mantle (021 St 50258) in October. The track tensioning tool is in the starboard socket on the rear plate, it has been used by locals to reduce the tension of the tracks to enable easier access to the Panther's road wheels. The *Balkenkreuze* have been painted on the *Turm* sides but not on the rear of the *Fahrgestell*, this national marking combination was fairly common on *Pz.Bef.Wg.* Panthers. (Tony Krier VDL)

M·A·N *Panzer Befehls Wagen* Panther *Ausf.* G
September 1944
"Classic" Camouflage Scheme



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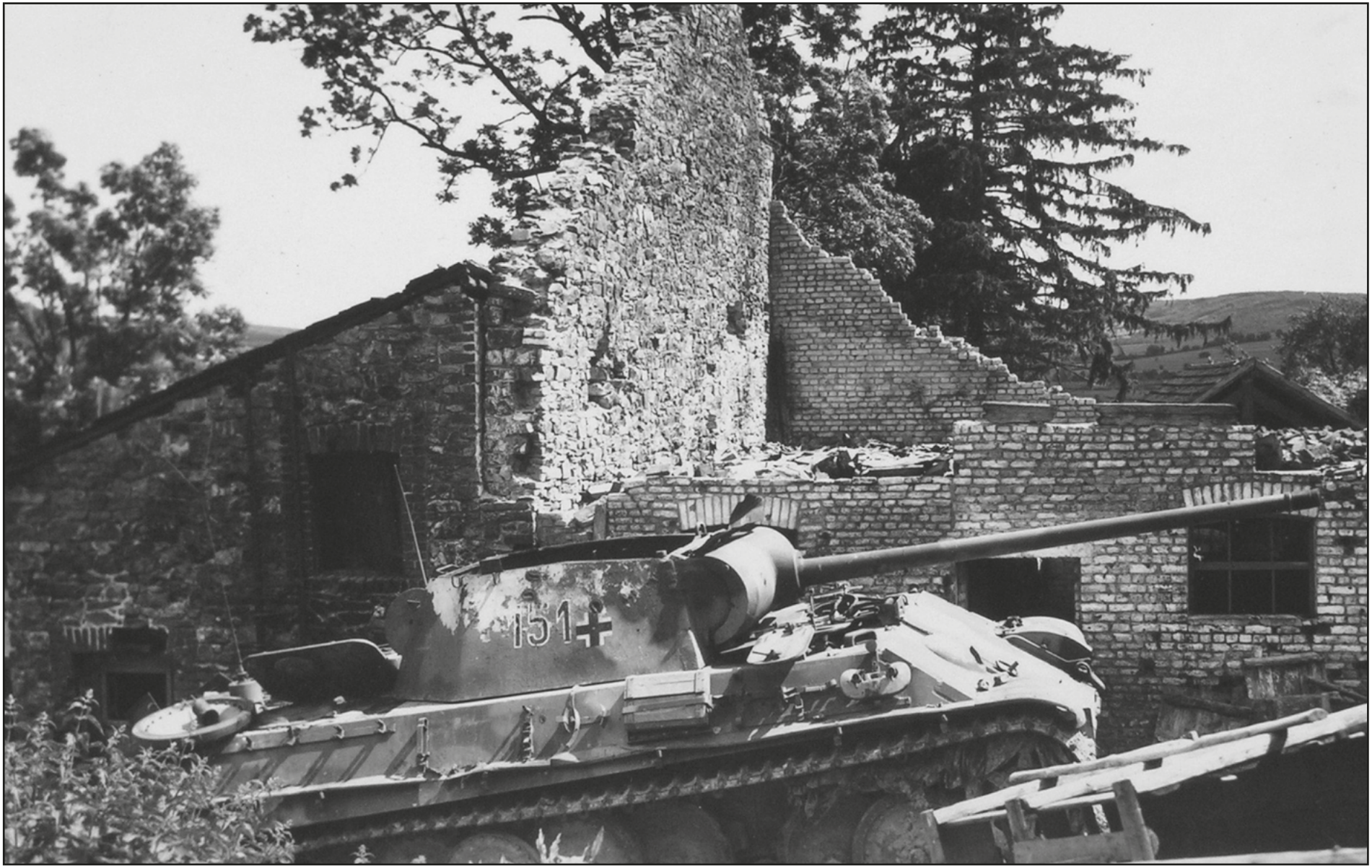
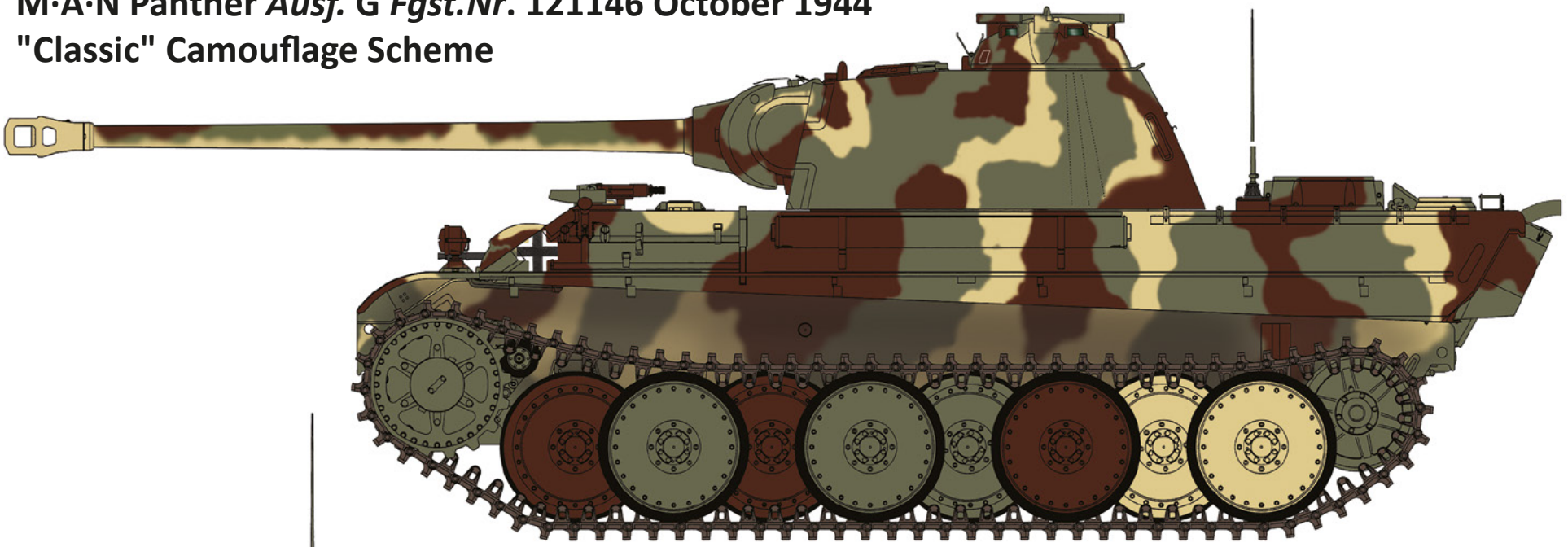
(Continued from page 189) **issued to units from Grafenwöhr. To illustrate this point as well as provide an example of the familial similarity evident in groups of Panthers completed in "Classic" standardised factory applied camouflage we have included a profile of the other *Pz.Bef.Wg.* Panther completed by M·A·N in September and subsequently issued to Stab I./SS-Pz.Rgt. 1. The familial similarity in the size shape and placement of the colour fields that can be seen on all of the Panthers completed in the "Classic" standardised factory applied camouflage scheme irrespective of whether they were completed by Daimler-Benz or M·A·N. Within these two groups there are also specific details in the execution of these schemes that can be used to identify the assembly plant that completed a particular Panther. If we use the analogy of a radio wave to try and describe the characteristics of the *Dunkelgelb* line that was part of the "Classic" factory applied schemes starboard side of the *Türme*, M·A·N have a wavy *Dunkelgelb* RAL 7028 line that usually travels from just in front of the *Lost Erkennungstafeln* down to the lower interlock on *Turm* side and front plate. This has one or two waves with a short wavelength and amplitude before one or two waves with progressively longer wavelength and amplitude returning around the area of the lower interlock. The *Dunkelgelb* RAL 7028 line on Daimler-Benz Panthers typically have a line that starts further back on the upper *Turm* edge the wavelength and amplitude of which is only slightly longer progressively longer going forward returning around the upper front plate interlock. There is a degree of variation in these norms between each of the vehicles but there is also a lot of familial similarity between Panther completed by the same assembly firm. There are also similar detail differences that are typically found on Panther gun mantles, Daimler-Benz vehicles often have a *Dunkelgelb* RAL 7028 lobe above the gunsight aperture that is not usually found on Panthers completed by M·A·N. Similarly there is often a thin *Dunkelgelb* stripe on the starboard side of the gun tube aperture of M·A·N Panthers that makes its way up to the welded elevation stop on the top of the trunnion armour that is not usually present on Daimler-Benz Panthers. There are also features of the scheme on the *Fahrgestell* such as the *Dunkelgelb* lobe that M·A·N painted above the *Kugelblende* that is usually further over to the starboard side on Daimler-Benz vehicles.**



The *Panzer Befehls Wagen* Panther completed in "Classic" standardised factory applied camouflage illustrated in the profile on the opposite page. This Panther completed by M·A·N in September and the *Rotbraun* RAL 80127 colour field displays the typical attributes of M·A·N Panthers painted in this scheme. The *Turm* roof and the commander's cupola was blown out by Allied troops from the 105th Eng Bn in late December 1944 following the vehicles capture during the Ardennes Offensive in La Gleize. M·A·N Panthers in this scheme have a wavy *Dunkelgelb* RAL 7028 line that usually travels from just in front of the *Lost Erkennungstafeln* (Poison gas detector panels) down to the lower interlock on Turm side and front plate. A significant number of *Pz.Bef.Wg.* Panthers had an alternative placement where the *Balkenkreuze* were only applied to the *Türme* sides with the rear plate bereft of this marking, this vehicle has this *Balkenkreuze* national marking combination. (Freddy Lemaire LUMA)

M·A·N Panther *Ausf.* G *Fgst.Nr*. 121146 October 1944
"Classic" Camouflage Scheme



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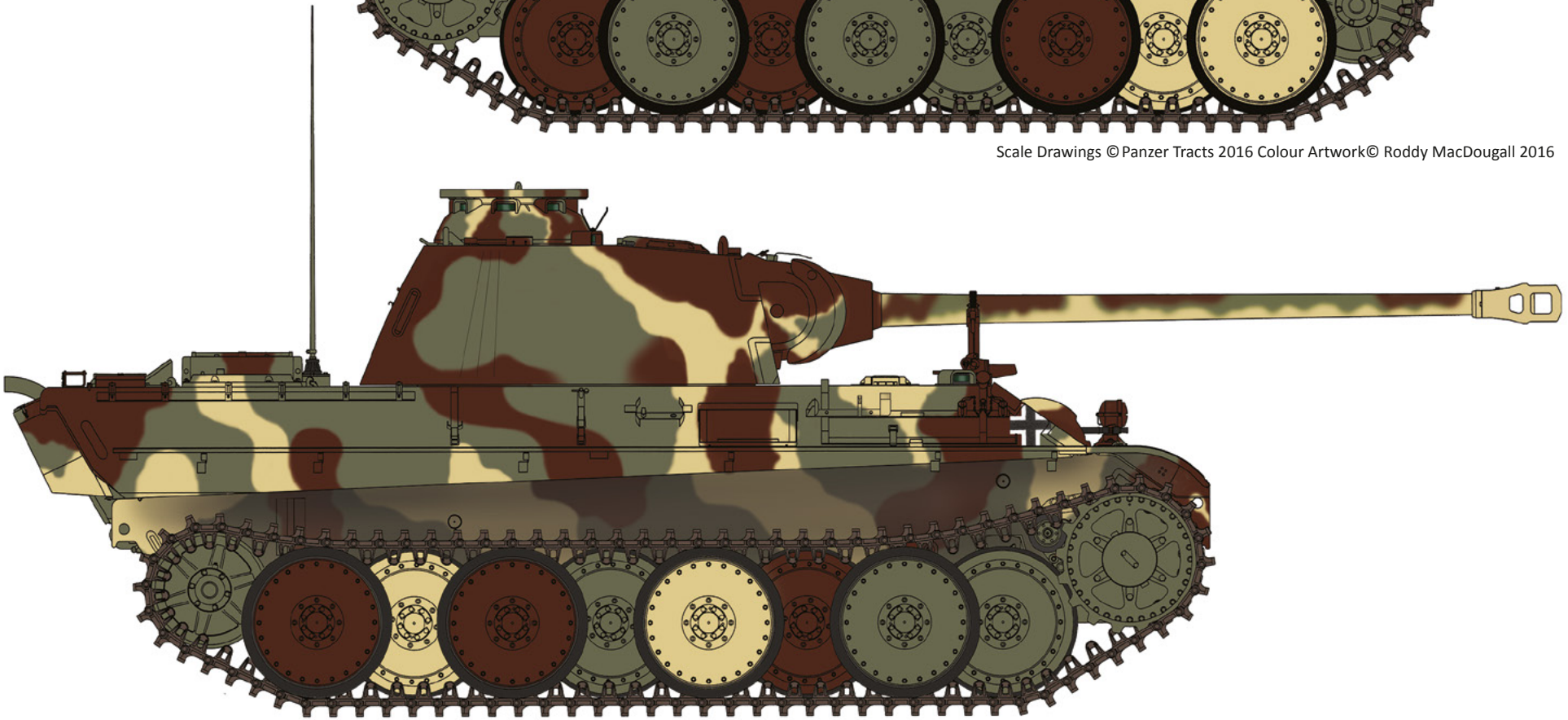

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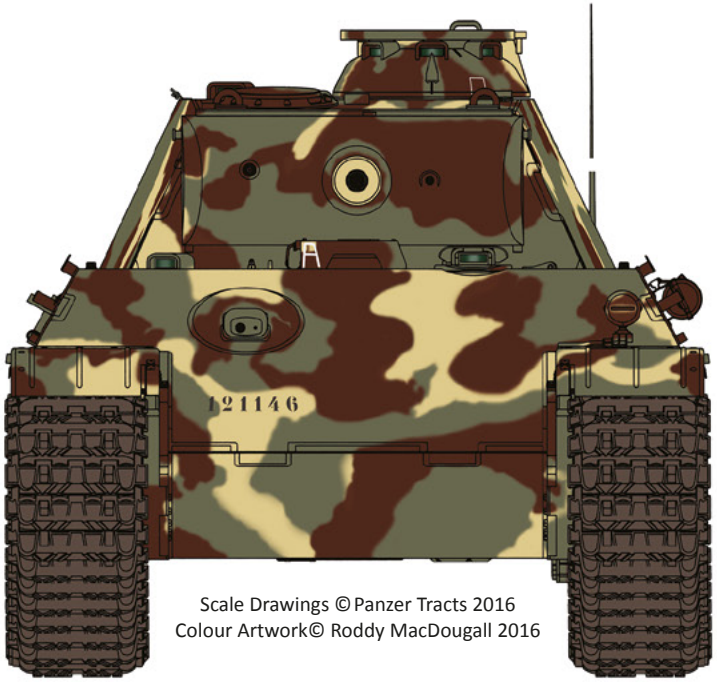

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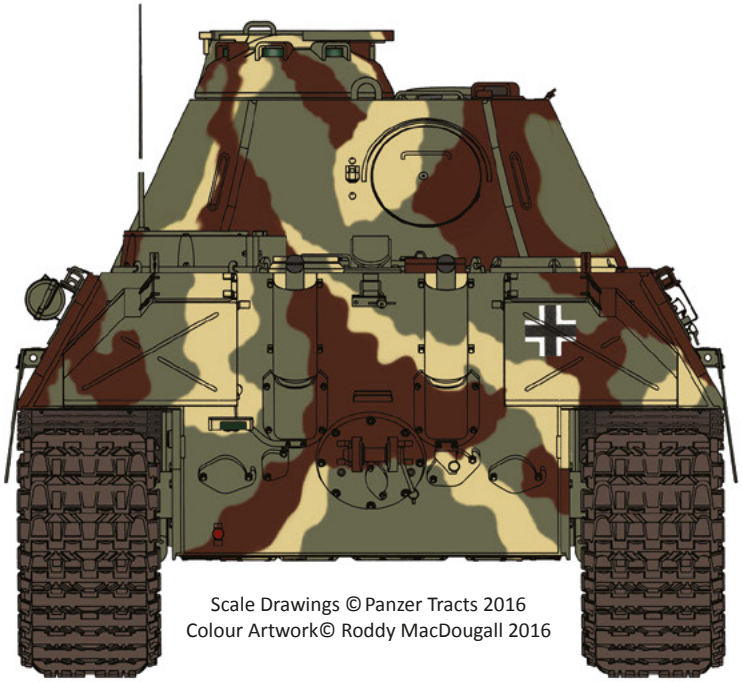

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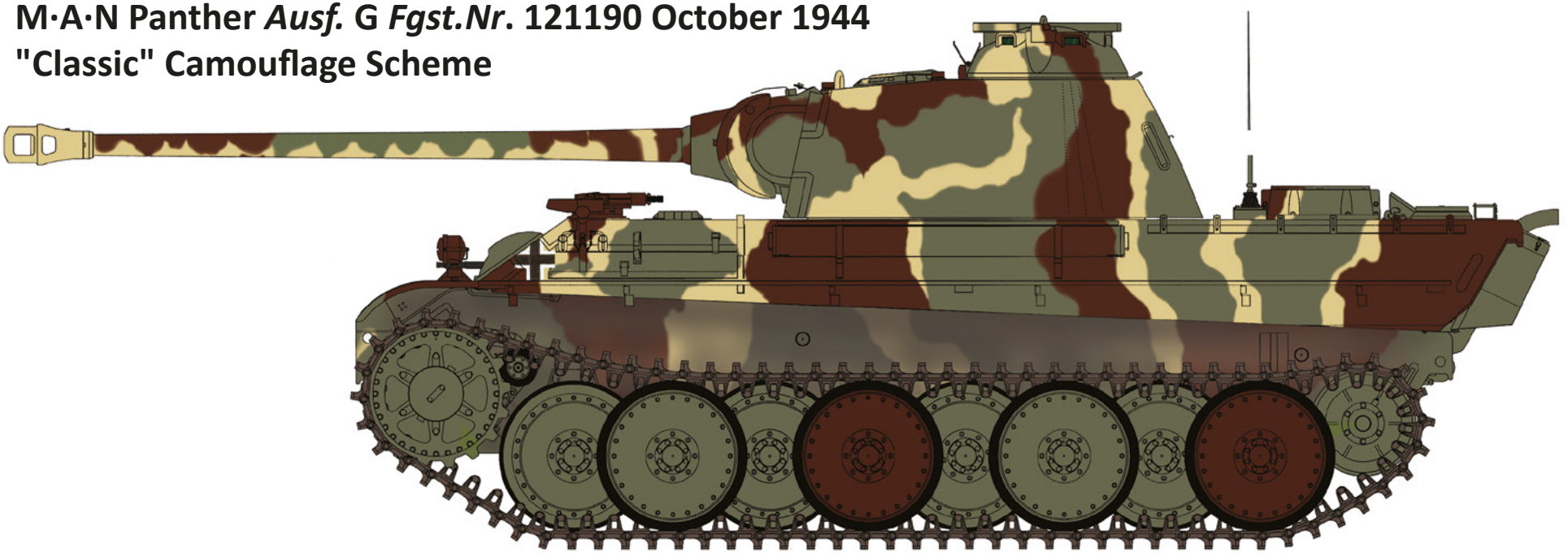
Panther *Fgst.Nr.* 121146 was completed by M·A·N on or about 14th October 1944. It was finished in the *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 standardised "Classic" factory applied camouflage scheme. There was now very little variation on the colour fields applied to the glacis and gun mantle from the beginning of October through to this pattern being replaced at the end of November. The distinctively shaped *Dunkelgelb* RAL 7028 colour field flanked by a *Rotbraun* RAL 8017 field on the starboard side and either *Rotbraun* RAL 8017 or *Olivgrün* RAL 6003 on the port side can be found on the overwhelming majority of Panthers completed by M·A·N during this period. The shape and location of the *Dunkelgelb* RAL 7028 lobe above the Kugelblende is also a typical feature on M·A·N Panthers finished in this scheme. This Panther was fitted with the large diameter 665mm self cleaning *Leiträder* (idler wheels) introduced by M·A·N in October. A new stencil had been used for the *Fahrgestell* number on M·A·N Panthers since the beginning of July. This number was now typically stencilled on the glacis plate rather than the gun travel lock, however a few vehicles would still have this applied to the travel lock using the "*Preußische IV 44 Ausgabe 3*" font up to the end of December. The "*Wischer u Stange*" (cleaner and rods) marking was no longer applied to the side of the gun cleaning tools tube, however, the abbreviated "*Verlade Klasse Schwere*" (heavy load class) stencil was still required by the Reichsbahn for rail transport and is frequently visible on Panthers completed post September 1944. The *Balkenkreuze* national markings have been applied to the front corners of the *Fahrgestell* just ahead of the tool stowage brackets on both the port and starboard side, the location of the rear *Balkenkreuz* was the starboard side *Gepäckkasten* (stowage bin). The areas of the lower *Fahrgestell* that would be inaccessible once the running gear had been installed were painted using *Dunkelgelb* RAL 7028, *Rotbraun* RAL 8017 or *Olivgrün* RAL 6003 prior to the installation of the running gear. There is considerable variety to the shape, size and location of these fields which frequently do not match those applied to the rest of the vehicle when its assembly was complete. Shade cards for the *Dunkelgelb* RAL 7028, *Rotbraun* RAL 8017 or *Olivgrün* RAL 6003 paints used on these vehicles were part of a kit supplied to all of the assembly plants for use during the *Abnahmestelle* procedure. These would be used by the assembly plants inspectors as well as the *Heeres-Waffenamt* inspectors and would allow them to accurately compare the colours used on the vehicle with the approved colours on the shade cards. Each of the colours was sampled in a number of areas to enable a fair comparison to be made between the shade cards and the paint on the vehicle. If these were not within the acceptable tolerances specified by the *Heeres-Waffenamt* then the vehicle would need to be repainted in the correct colours.

Left:
Panther *Fgst.Nr.* 121146 (left) tactical number 327 is the subject of the colour plates on pages 194 and 195 and can also be seen in the background of the photograph on page 277. It was completed by M·A·N on or about 14th October 1944 and was one of several Panthers finished in the *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 standardised "Classic" factory applied camouflage scheme completed by M·A·N in October that were issued to I./SS-Pz.Rgt. 12 prior to the Ardennes Offensive. There was now very little variation on the colour fields of Panthers completed in this scheme by M·A·N from the beginning of October through to this pattern being replaced at the end of November. The distinctively shaped *Dunkelgelb* RAL 7028 colour field flanked by a *Rotbraun* RAL 8017 field on the starboard side and either *Rotbraun* RAL 8017 or *Olivgrün* RAL 6003 on the port side can be found on the overwhelming majority of these Panthers completed by M·A·N during this period. The shape and location of the *Dunkelgelb* RAL 7028 lobe above the *Kugelblende* and the stripe running down the gun mantle on the starboard side of the gun tube aperture are also a typical features on M·A·N Panthers during this period. This Panther was fitted with the large diameter 665mm self cleaning Leiträder (idler wheels) that were introduced by M·A·N in October. (Haasler, MacDougall, Thomson & Vosters)

Opposite Page:
A comparison of the colour fields on the glacis plate of Panther tactical number 127 from 1./SS-Pz.Rgt. 12 on the left of the photograph overleaf is an indication of the consistency with which this scheme was applied by M·A·N. The first 4 digits of Panther 127's *Fahrgestell* number (1211XX) are visible in another photograph of this vehicle confirming it was completed by M·A·N in October or early November 1944. Note the *Dunkelgelb* RAL 7028 crescent on the upper port corner of the Turm. Panther tactical number 127 was knocked out along with another vehicle, Panther tactical number 135, also assembled by M·A·N in October or early November at the Lausdell crossroads northeast of Rocherath, Belgium on 18th December 1944. (NARA via Darren Neely)

M·A·N Panther *Ausf.* G *Fgst.Nr*. 121190 October 1944 "Classic" Camouflage Scheme



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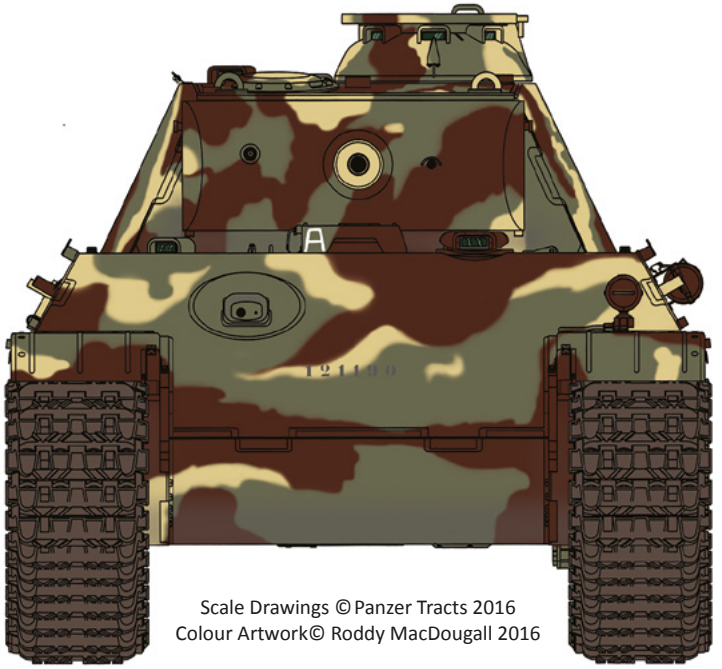
There are exceptions to almost every rule and it would be fair to say that the camouflage scheme applied to the glacis plate and gun mantle of Panther *Fgst.Nr.* 121190 is one of these. This Panther was completed on or about 22nd October at the M·A·N plant in Nürnberg. The camouflage pattern applied to the port side can be clearly seen in numerous period photographs taken over the course of 1945 until it was scrapped in 1946. This is a fairly typical application of the *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 standardised "Classic" factory applied camouflage scheme's port side on a Panther completed by M·A·N. There tends to be more variation to the size and shape of colour fields applied to the front and rear elevations of all of the vehicle types painted in standardised factory applied camouflage schemes, however there are usually recognisable features on Panthers painted in the "Classic" factory applied camouflage that can be used to determine which assembly plant completed a particular vehicle. Other than the slightly more diffuse edges to the colour fields and the *Fahrgestell* number stencilled on the glacis plate it would be fair to say that the camouflage on the glacis of Panthers *Fgst.Nr.* 121190 is atypical of the "Classic" factory applied camouflage scheme. This Panther was fitted with 600mm *Leiträder* (idler wheels) which were still being installed on a small number of Panthers by M·A·N. Road wheels were painted in one of the standard colours that made up the camouflage scheme and then installed randomly on the vehicle, there was no stipulation regarding the number of wheels in each colour to be fitted to each vehicle.



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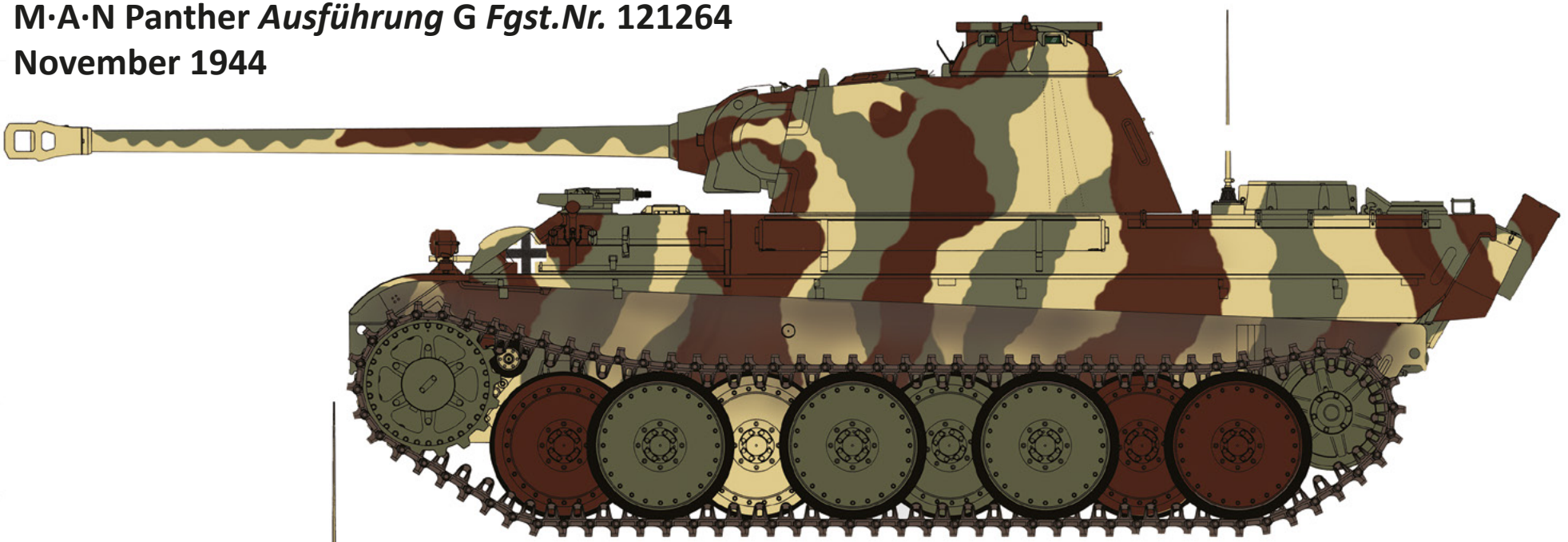
This photograph of Panther *Fgst.Nr.* 121190 shows the *Dunkelgelb* RAL 7028 counter shading on the bottom of the *7.5cm Kw.K.42 L/70* main gun which was common to almost all of the Panthers completed by M·A·N in one of the standardised factory applied camouflage schemes. The light conditions when the photograph was taken allow the camouflage paint on the lower *Fahrgestell* behind the running gear to be seen reasonably clearly. The early pattern 600mm diameter *Leitrad* (idler wheel) is still fitted to the port side, it would disappear along with the road wheels within a few weeks, it was common practice for these to be removed by enterprising locals who would strip knocked out German vehicles of anything that could potentially be useful. This Panther was issued to I./SS-Pz.Rgt. 2 in November 1944, it was knocked out at Trou de Loup southwest of the village of Grandmenil during the Ardennes Offensive. (Jean Petite via Cuivre Plié)

This Panther was completed by M·A·N in the "Classic" factory applied camouflage scheme and issued to II./Pz.Lehr-Rgt. 130 prior to being abandoned in Hoscheid, Luxembourg in January 1945 following the failure of the Ardennes Offensive. The first five digits of this Panther's *Fahrgestell* number (12126X) can be seen in this photograph, the last digit is obscured by the row of *Mittelstollen* (ice grips) hung on the glacis plate. The upper part of the last digit can be seen in another photograph, this is curved indicating that this digit is either a 0 or a 2. Both Panther *Fgst.Nr.* 121260 and Panther *Fgst.Nr.* 121262 were completed on or around 27th November indicating this is one of the last Panthers completed in the "Classic" factory applied camouflage scheme before it was superseded the following day by the new scheme used for Panther *Fgst.Nr.* 121264 on. (Tony Krier via Dieter Laes)

This Panther tactical number 301 is from 3./Pz.Rgt. 3, it was abandoned in the village of Clervaux, just south of the River Our on the border between Luxembourg and Germany. It is one of the first series production Panthers to be equipped with *Flammenvernichter* (flame suppressing exhausts) and one of the last vehicles completed by M·A·N in the "Classic" factory applied camouflage scheme in late November 1944. A good quality scan of the original print reveals that the "contrasting spot" overlay on this Panther is in fact two isolated spots of *Dunkelgelb* RAL 7028 just to the rear of the bend in the *Turm* armour accompanied by a combination of road dirt and debris accumulated during the road march. This is accompanied by some pock marks in the armour plate caused by small arms or shell splinters. (NARA via Darren Neely)

M·A·N Panther *Ausführung* G *Fgst.Nr.* 121264
November 1944



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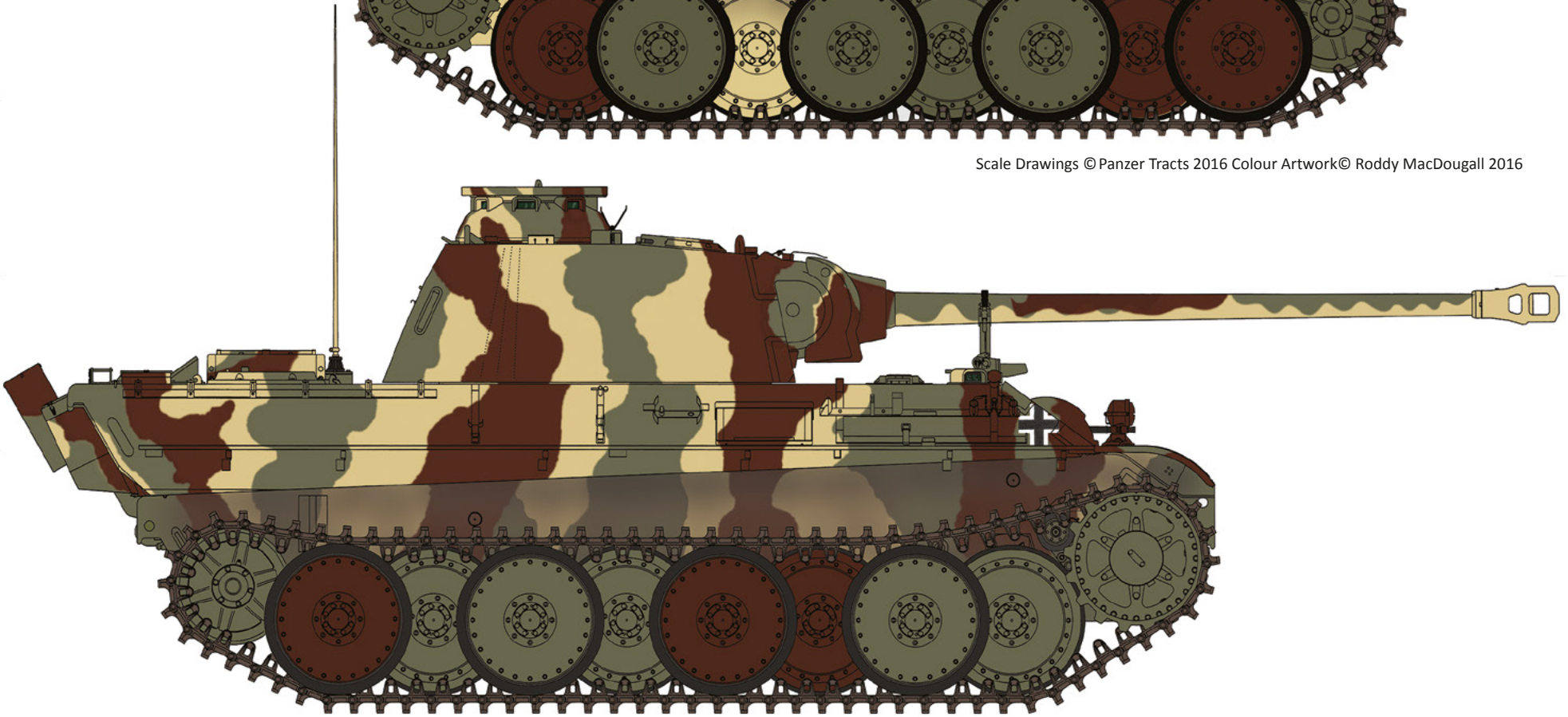

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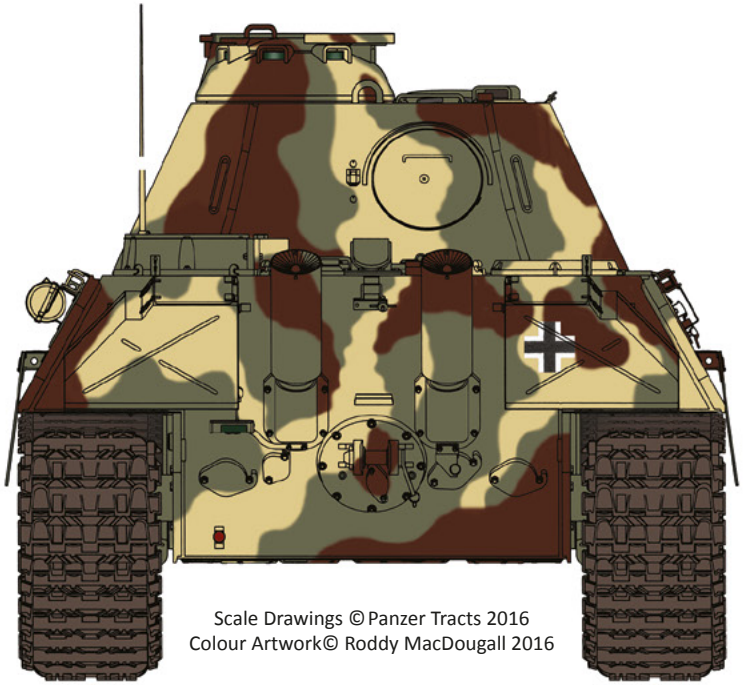

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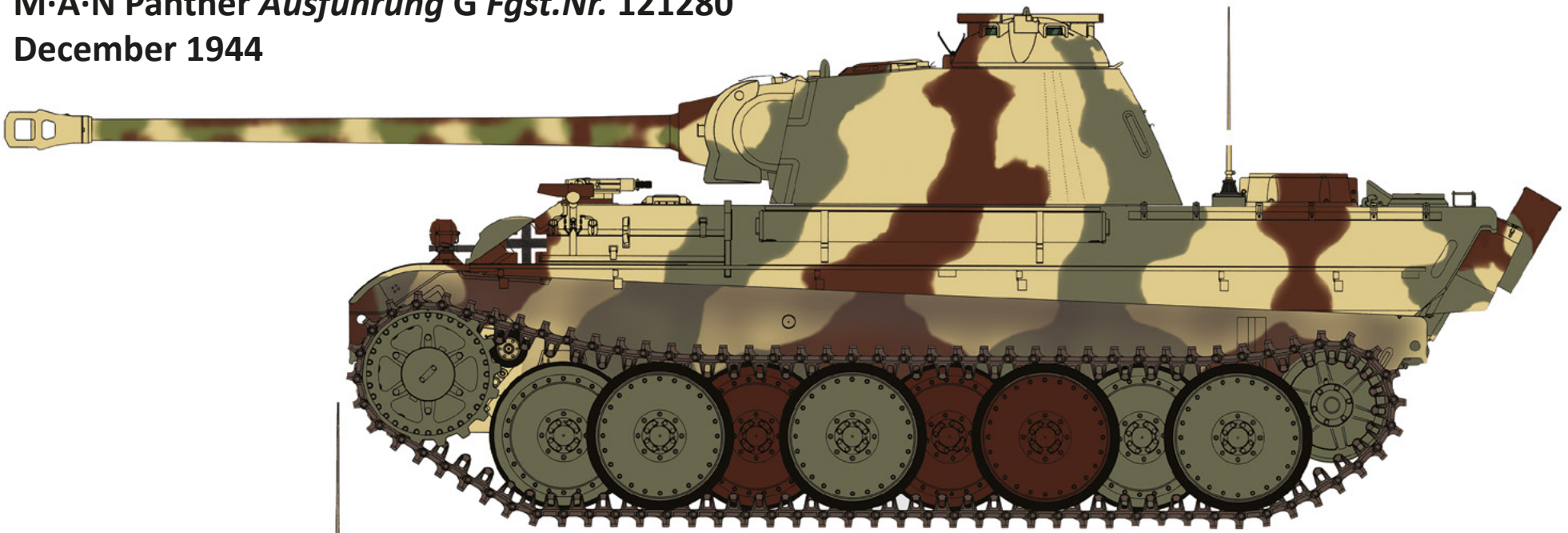
M·A·N start completing Panthers in a new *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme towards the end of November, Panther *Fgst.Nr.* 121264 completed on or about 28th November is the earliest vehicle identified to date in this new scheme. A major component of the new scheme were bands of colour that crossed the vehicle vertically along with smaller colour fields that are more prominent on the port side of the vehicle, the concept is similar to the M.N.H. striped scheme but the execution is dissimilar so that the two schemes can not be confused. The vertical bands of colour on the new M·A·N scheme undulate significantly more and do not have the consistency of form apparent on Panthers completed by M.N.H. at this point. There are key features in all of the standardised factory applied camouflage schemes that are apparent on the groups of vehicles painted in them. This does not mean that all the vehicles painted in any one of the schemes are identical to each other but share a familial similarity. All of the standardised camouflage patterns applied by M·A·N show considerably more diversity between vehicles than those used at either Daimler-Benz or M.N.H. As was the case with all of the factory applied camouflage schemes the camouflage continued over the *Fahrgestell* and *Turm* roofs, some care was taken to match the pattern up but inevitably there are areas where the painters had finished two adjacent panels where all of the colour fields did not match on both panels. There is no evidence of the "nobody cared" attitude that has been popularised by some. This new camouflage scheme would replace the variations of the "Classic" factory scheme that M·A·N had used on the majority of the Panthers they had completed since the end of September, the last vehicle with an identifiable *Fahrgestell* number known to have been painted in this scheme is a Panther from II./Pz.Lehr-Rgt. 130 abandoned at Hoscheid in Luxembourg during the Ardennes Offensive that can be seen on page 200. The first 5 digits of the Fgst.Nr. 12126X of this Panther can be clearly made out on the original print. There is another photograph of this Panther that we are unable to publish where enough of the last digit is visible to determine that the number is either 2 or 3 indicating this Panther was completed around the same time as Panther *Fgst.Nr.* 121264. M·A·N would start to complete Panthers fitted with *Flammenvernichter* (flame suppressing exhausts) towards the end of November, Panther *Fgst.Nr.* 121264 was fitted with the new exhausts several days after M·A·N had completed the first series production Panthers fitted with these new exhausts. Almost all of the Panthers completed by M·A·N would be fitted with forged armoured exhaust elbows, these did not completely replace the older welded component which could still be seen on new Panthers completed by all of the assembly firms in 1945. This Panther was knocked out by a Bazooka team on the road between Hampteau and Menil-Favay during combat with the British 53rd(Welsh) Inf Div and B Squadron, 144th RAC Regiment from the 33rd Armoured Brigade that began on 3rd January 1945.

M·A·N start completing Panthers in a new camouflage scheme towards the end of November, Panther *Fgst.Nr.* 121264 completed on or about 28th November is the earliest vehicle identified to date in this new scheme. A major component of the new scheme were the bands of colour that crossed the vehicle vertically along with smaller colour fields that are more prominent on the port side of the vehicle, the concept is similar to the M.N.H. striped scheme but the execution is dissimilar so that the two schemes can not be confused. The camouflage continued over the *Fahrgestell* and *Turm* roofs, some care was taken to match the pattern on the roof and side panels. This Panther was amongst a group of new vehicles issued to I./Pz.Rgt. 16 just prior to the Ardennes Offensive, a set of hastily painted yellow tactical numbers (703) were applied to the upper front corners of the Turm sides one these Panthers. (Leon Pirlet via Jean-Michel Delvaux)

The new camouflage scheme consisted of distinct bands of *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 that travelled vertically over the vehicle that can clearly be seen in this photograph of Panther *Fgst.Nr.* 121280. This remarkably clear photograph was taken just north of the Rue du Refuge and Rue du Calvaire crossroads on the outskirts of Verdenne. This is one of the very few Panthers completed by M·A·N in 1944 with a standardised factory applied camouflage scheme where there is no *Dunkelgelb* RAL 7028 counter shading on the gun barrel. The urethane resin camouflage paint applied over the white markings painted on the glacis plate during the assembly process such as the *Fahrgestell* number is starting to wear off revealing the markings below. (Jean-Michel Delvaux)

M·A·N Panther *Ausführung* G *Fgst.Nr.* 121280
December 1944



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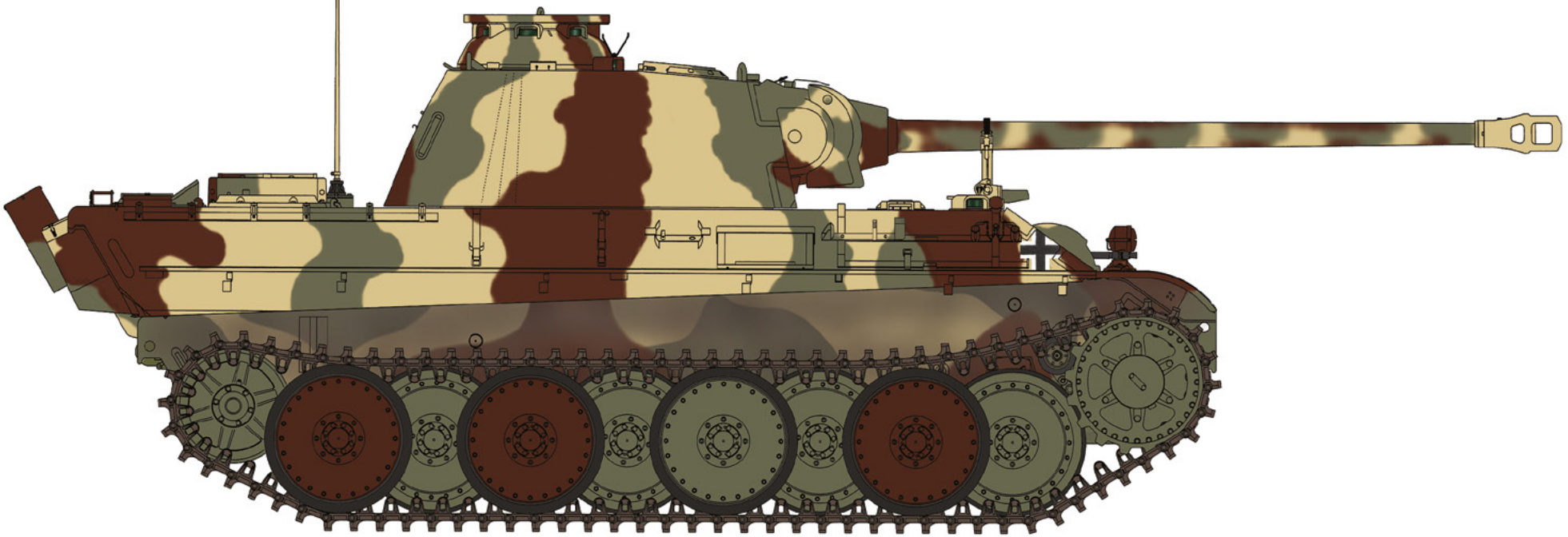

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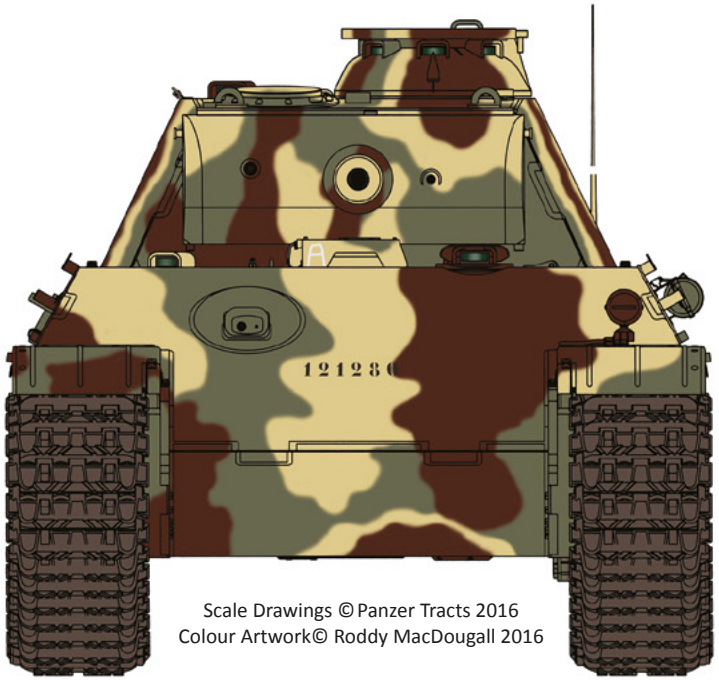

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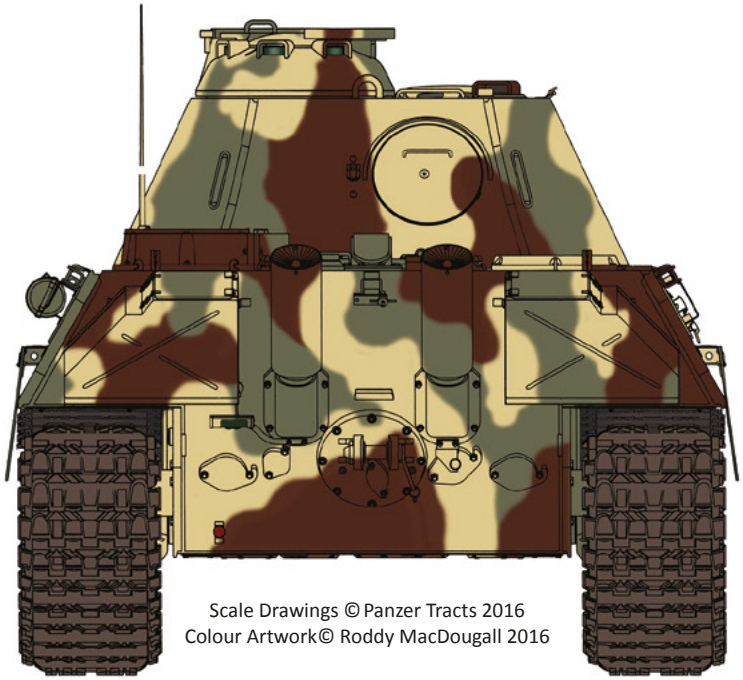

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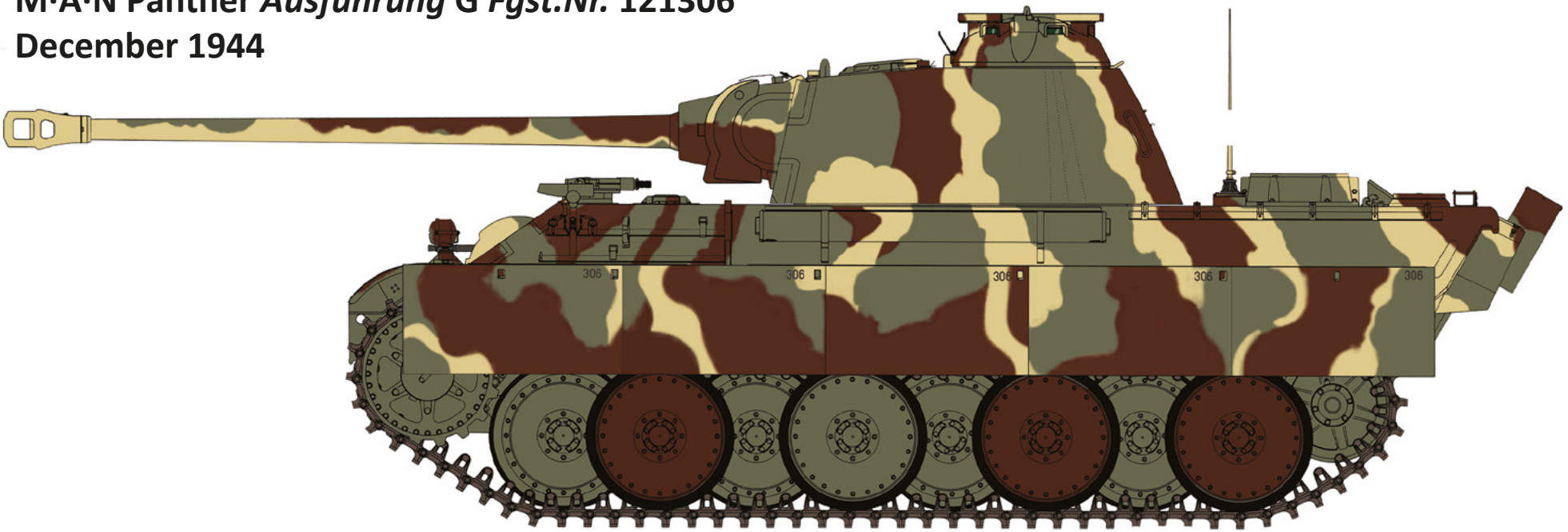
Panther Fgst.Nr. 121280 was completed by M·A·N on or around 2nd December 1944 and was painted in what is probably the least elaborate interpretation of the new standardised camouflage pattern introduced by M·A·N some four days earlier. M·A·N had always been allowed considerably more latitude in the interpretation of the templates for the standardised factory applied camouflage schemes sent to them by the *Heeres-Waffenamt* than that conceded to either Daimler-Benz or M.N.H. by the *Heeres-Abnahmestelle* inspectors at these two assembly plants. Panther *Fgst.Nr.* 121280 has been painted in *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 colour fields that cross vertically over the vehicle and are almost completely separated by wide bands of *Dunkelgelb* RAL 7028 on the Panther's side elevations. The urethane resin paint is incredibly thin and any markings applied to the *Fahrgestell* during its assembly stand slightly proud of the surface and the paint wears of these faster than the surrounding areas. The Dunkelgelb RAL 7028 counter shading on the 7.5cm Kw.K.42 L/70 main gun that is usually a feature of Panthers assembled by M·A·N has been replaced by loosely sprayed *Rotbraun* RAL 8017 on the lower surface of the gun barrel. The *Balkenkreuze* national markings have been painted on forward of the tool stowage brackets on the *Fahrgestell* sides and the starboard *Gepäckkasten*. The flat topped "A" has been applied to the gun travel lock following the Panther's acceptance for service with the *Wehrmacht* by the *Abnahmestelle* inspectors at the M·A·N assembly plant in Nürnberg. This Panther was issued to I./Pz.Rgt. 16 who rejoined their parent 116.Pz.Div. in November. The Panthers in Pz.Rgt. 16 were in the I. *Abteilung* so the tactical numbers given to the new Panthers that were received are a little strange in that they would normally indicate vehicles in the II. *Abteilung* who were equipped with Panzer IV's. This Panther has the tactical number 605 painted in yellow on the upper corners of the *Turm* sides. It took part in the fighting with elements from the 333rd Inf Rgt and 334th Inf Rgt from the U.S. 84th Inf Div around Verdenne where it was abandoned at the Rue du Refuge and Rue du Calvaire crossroads on the night of 26th December 1944 when the German forces in the village withdrew on foot leaving all of their heavy equipment behind.

Following the introduction of any of the new camouflage schemes used by the assembly plants there tends to be more variation to the colour fields applied to the initial vehicles completed, this is particularly noticeable on new vehicles completed by M·A·N. Panther *Fgst.Nr.* 121290 was completed by M·A·N on or around 5th December 1944, it was one of 23 Panthers that were issued to I./Pz.Rgt. 16 on 11th and 12th of December just prior to the start of the Ardennes Offensive on 16th December 1944. If we compare this remarkably sharp and clear photograph of Panther *Fgst.Nr.* 121290 with Panther *Fgst.Nr.* 121306 completed by M·A·N on or around 10th December illustrated overleaf we can see the same consistent familial similarity evident on Panthers finished in the new standardised factory applied camouflage scheme. (Jean-Michel Delvaux)

The general shape and location of the colour fields on Panther *Fgst.Nr.* 121290 match those of Panther *Fgst.Nr.* 121306 which is the subject of the next colour plate. As with all of these patterns they are not completely identical as they were copied from a scale drawing showing the location and shape of the colour field that then had to be scaled up and applied to the vehicle. Although there are some charred sections of paint on Panther *Fgst.Nr.* 121290 the *Dunkelgelb* RAL 7028 lobe on the lower port side of the *Turm* is similar in size, shape and location as is the *Dunkelgelb* RAL 7028 stripe running from the front of the commander's cupola down over the *Turm* side onto the *Fahrgestell* on both vehicles. There are several photohraphs of Panther Fgst.Nr. 121290 that were taken before components were stipped off that show the white flat topped "A" marking was applied to the external travel lock. (Leon Pirlet via Jean-Michel Delvaux)

M·A·N Panther *Ausführung* G *Fgst.Nr.* 121306 December 1944



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Panther *Fgst.Nr.* 121280 was completed by M·A·N on or around 2nd December 1944, it was one of 23 Panthers including Panther *Fgst.Nr.* 121290 completed on or around 5th December by M·A·N that were issued to I./Pz.Rgt. 16 on 11th and 12th of December just prior to the start of the Ardennes Offensive on 16th December 1944. If we include Panther *Fgst.Nr.* 121264 completed on or around 28th November that was issued to I./Pz.Rgt. 16 on 7th December and Panther *Fgst.Nr.* 121306 completed by M·A·N on or around 10th December we have this group of vehicles that were completed by M·A·N over a ten day period from which we can make comparisons of the standardised factory applied camouflage scheme then in use. We have chosen to depict Panther *Fgst.Nr.* 121306 for this colour plate as it is a brand new undamaged vehicle that is well known to those with an interest in the Panther's design and development. Following the introduction of any of the new camouflage schemes used by the assembly plants there tends to be more variation to the colour fields applied to the vehicles completed in the next week to 10 days before the assembly plants are familiar with the scheme and how best to apply it. This is particularly noticeable on the initial vehicles completed by M·A·N. Readers will notice the familial resemblance between Panther *Fgst.Nr.* 121290 on pages 208 and 209 and Panther *Fgst.Nr.* 121306 as depicted in this series of colour plates. This scheme would continue to be used on the Panthers completed by M·A·N up to 1945 and the small number of Panthers completed in January following the collapse of production at the Nürnberg assembly plant. M·A·N would start

to fit *gummigefederte Stahllaufrollen* to the 8th road wheel station of all of the new Panthers it assembled a week to ten days after Panther *Fgst.Nr.* 121306 was completed. The *Schürzen* were painted in racks or stands as a set using the templates appropriate to the camouflage scheme sent by the *Heeres-Waffenamt*. They were not matched to any one vehicle but as we can see they were frequently marked by the crew or unit *Werkstatt* with the last digits of the vehicles *Fahrgestell* number and the letter L (Links or left) or (Rechts or right). This Panther has also been marked with "*Glysantin geschützt 50*" underneath the *Kugelblende* on the glacis plate and a black circle applied to all of the test and development vehicles at Kummersdorf. It has not been marked with the flat topped "A" on the gun travel lock or *Balkenkreuze* national markings that were painted on after a Panther's acceptance for service with the Wehrmacht by the *Abnahmestelle* inspectors at the M·A·N assembly plant in Nürnberg. The "*Glysantin geschützt*" and its other associated markings are dealt with in detail in the chapter 9. of this book.

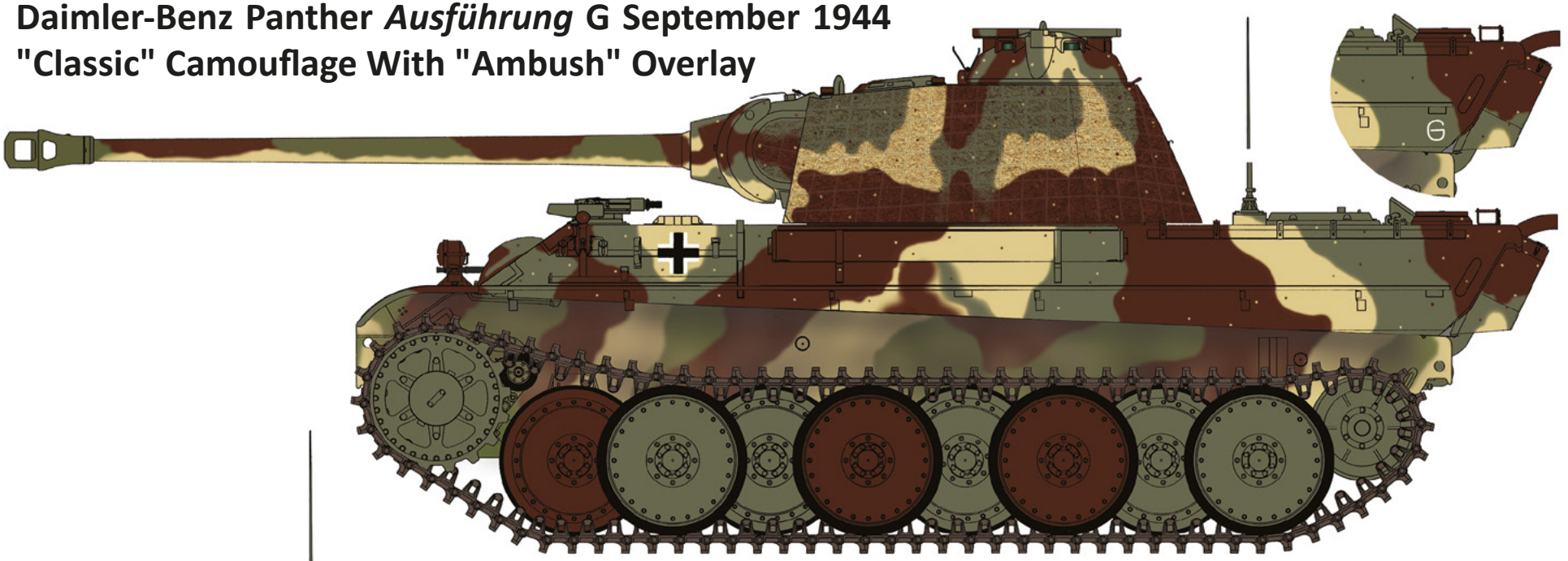
Panther *Fahrgestell* number 121306 had various messages chalked onto the *Schürzen* prior to leaving the assembly plant, an attempt has been made to remove these but this was not entirely successful. The vehicle was equipped with an *Antenne* and the hull mounted MG.34 machine gun but has no external stowage, this was normal practice for those vehicles that were selected to be used for research and development purposes. There is a remarkable similarity between the camouflage schemes applied to this vehicle and Panther *Fgst.Nr.* 121290 on pages 208 and 209. The lug on the commander's hatch swing arm discussed on page 142 can be seen just to the right of the hatch handle. It should be noted that there is no white "A" marking on the vehicles external travel lock as this Panther was assigned as a test and development vehicle and was never accepted for service with the *Wehrmacht*. (Hilary Louis Doyle)

DAIMLER-BENZ FACTORY APPLIED CAMOUFLAGE PATTERNS

Panther tactical number 202 was one of a small number of vehicles completed by Daimler-Benz in September 1944 with a coating of *Zimmerit* paste on the Turm shell but not the gun mantle or escape hatch. It was finished in the *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 standardised "Classic" factory applied camouflage scheme with a contrasting spot overlay that made up the "Ambush" element of this scheme on Daimler-Benz assembled Panthers between September and the end of October 1944. Another feature unique to Daimler-Benz Panthers during this period are the rows of spare tracks hung on the *Fahrgestell* sides at the assembly plant that were painted with *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 colour fields that are similar to, but not identical to, the colour fields on the *Fahrgestell* sides underneath the tracks. (Freddy Lemaire LUMA)

Daimler-Benz would not apply the "Classic" camouflage scheme with a true hard or sharp edge, it was carefully sprayed to control the amount of over spray at the edges of the colour fields. This pattern has certain prominent characteristics that are apparent in period photographs; the glacis almost invariably has a small patch of *Dunkelgelb* RAL 7028 above and to the starboard side of the *Kugelblende* MG ball mount. There is also a *Dunkelgelb* RAL 7028 stripe starting from around the driver's periscope or from the port *Fahrgestell* side extension that meanders towards the bottom starboard corner of the glacis before continuing down to the lower glacis plate and then making for the lower port corner. Another prominent feature is a *Dunkelgelb* lobe above the gunsight aperture on the gun mantle. (CEGESOMA)

Daimler-Benz Panther *Ausführung* G September 1944
"Classic" Camouflage With "Ambush" Overlay



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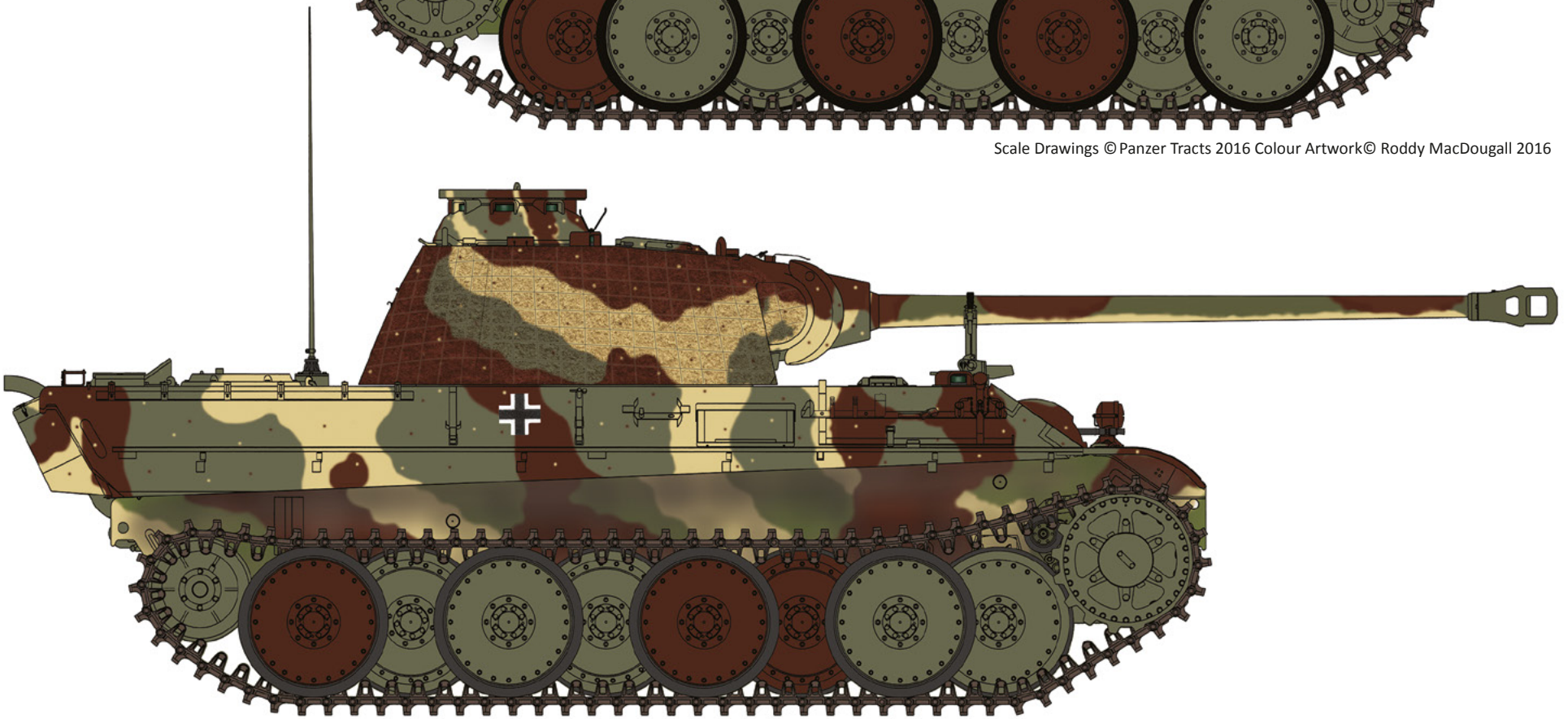

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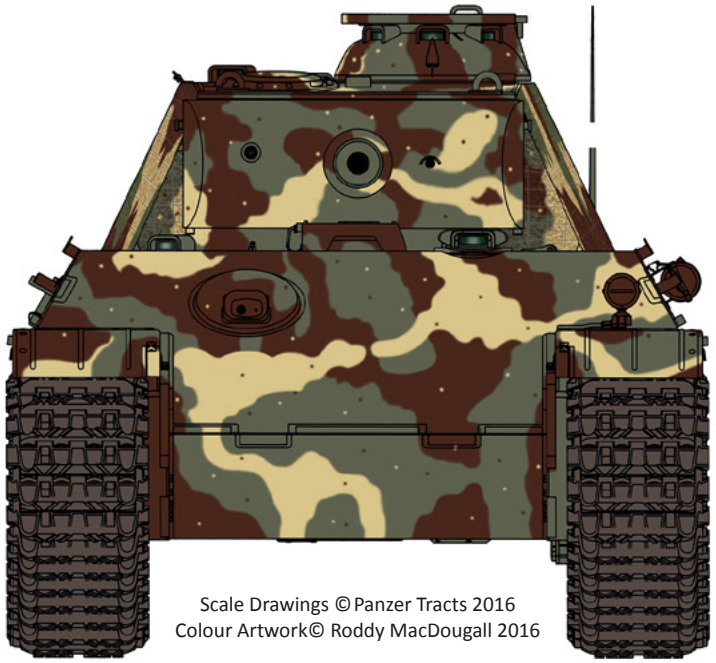

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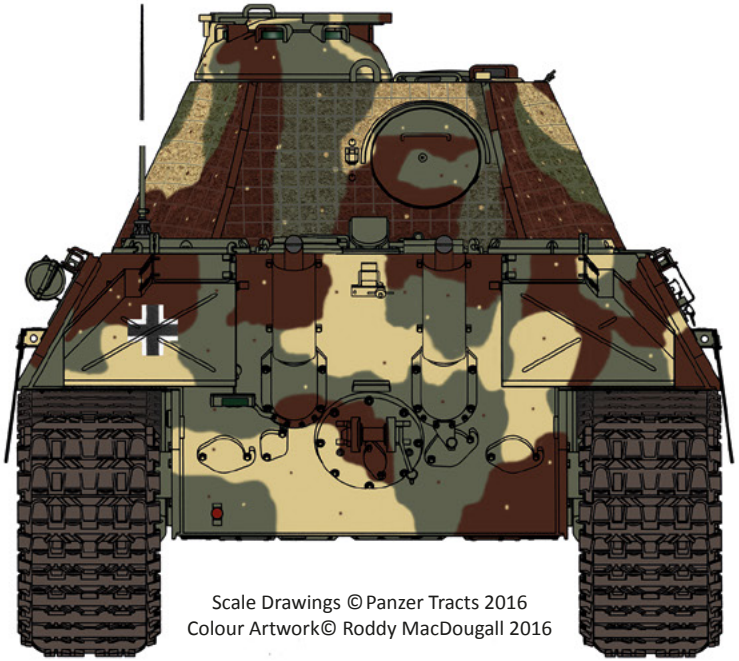

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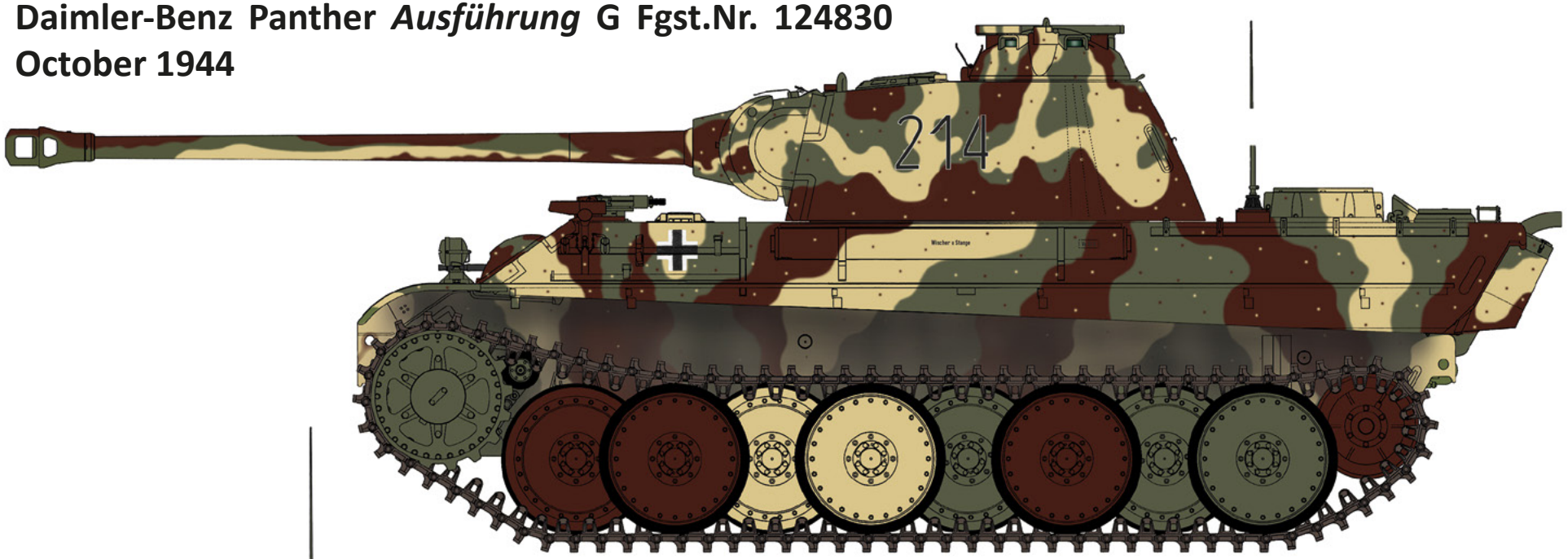
Daimler-Benz would finally adopt a standardised factory applied camouflage scheme shortly before the instruction to discontinue the application of *Zimmerit* paste was received. Prior to this all of the Panthers delivered by Daimler-Benz from February 1943 on were delivered in an overall coat of *Dunkelgelb* RAL 7028. We will call the camouflage scheme applied by Daimler-Benz the "Classic" factory pattern as the basic pattern was used by Daimler-Benz from September 1944 to the last weeks of the war with only one change and it would also be used by M·A·N for a short period that will be dealt with separately. Large areas of the vehicle were now covered with clearly defined areas of *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 that were sprayed on with great care. The colour fields had very clearly defined tightly sprayed edges with minimal over spray, the tightly sprayed edges achieved as a result of this is a defining characteristic of Panthers assembled by Daimler-Benz. The edges of these fields were so carefully applied that they almost have the appearance of having sharp edges in some period photographs. Daimler-Benz would not apply this camouflage scheme with a true hard or sharp edge. This pattern has certain prominent characteristics that are apparent in period photographs; the glacis has a small patch of *Dunkelgelb* RAL 7028 to the top starboard side of the *Kugelblende* M.G.34 ball mount. There is also a stripe of *Dunkelgelb* RAL 7028 starting from around the driver's periscope or from the port hull side extension that meanders towards the bottom starboard corner of the glacis before continuing down to the lower glacis plate and then making for the lower port corner. On the gun mantle there is a *Dunkelgelb* RAL 7028 band coming down from the *Turm* roof to the starboard side of the gun tube aperture or a lobe of *Dunkelgelb* RAL 7028 in the upper port corner. The *Turm* has a large area of *Dunkelgelb* RAL 7028 running diagonally from the lower interlocks back up to the mid point of the *Turm* side. The "Ambush" element that Daimler-Benz applied up to the end of October was an overlay consisting of small spots of camouflage paint applied to the larger colour fields of the main camouflage pattern. This was carefully applied using only two colours, the contrasting spot overlay to the main *Olivgrün* field consisted of *Dunkelgelb* RAL 7028 and *Rotbraun* RAL 8017 spots. The contrasting spot overlay applied to the main *Dunkelgelb* RAL 7028 fields consisted only of *Rotbraun* RAL 8017. The road wheels were individually painted in one of the colours from the camouflage scheme; they were painted prior to installation and then randomly selected so that there is no fixed order for any of the colours used or the number of wheels in a colour on any one vehicle. This Panther was issued to 2./SS-Pz.Rgt. 1 and took part in the Ardennes Offensive in December 1944 with the tactical number 202. It would eventually be abandoned intact in the village of La Gleize, Belgium.

Daimler-Benz would start to fit a debris guard over the gun mantle in September, shortly after this was introduced they also started to fit an *Orterkompass* mount and then *Lost Erkennungstafeln* on the *Türme* roofs. Note the lack of *Zimmerit* paste on the gun mantle and the *Ladeshutz* (Loaders) hatch on the *Turm* rear, both of these components were fitted after the instruction to cease the application of *Zimmerit* paste had been received. The white "G" was painted underneath the Schürzen rail on the *Fahrgestell* side by the vehicle's crew or the unit *Werkstatt*, this marking is one of several abbreviated forms of the name *Glysantin* used to indicate that the vehicles coolant system has been treated with this chemical compound. The camouflaged spare tracks can be seen to advantage in this photograph taken outside Joseph Boulanger's garage in La Gleize, Belgium on the N633 Roanne Coo Grand Route at the south east entrance to the village. (CEGESOMA)

The units serving on the Eastern Front were advised that they could repaint the white borders of the *Balkenkreuze* red as there had been reports that Soviet gunners had been using these as an aiming reference. This Daimler-Benz assembled Panther from I./Pz.Rgt. 31 (note the Devil's head insignia just ahead of the tactical number) is one of the small number of Panthers photographed with these modified markings. The vehicle has been finished in the "Classic" standardised *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme with contrasting spot overlay by Daimler-Benz between late September to mid October 1944. Daimler-Benz would still complete Panthers up to mid October 1944 with the original design of cast exhaust armoured guards. These would be replaced by the new forged design as seen on Panther *Fgst.Nr.* 124830 currently on display in Grandmenil and the subject of the next colour plates. (Transocean-Europapress)

Daimler-Benz Panther *Ausführung* G Fgst.Nr. 124830
October 1944



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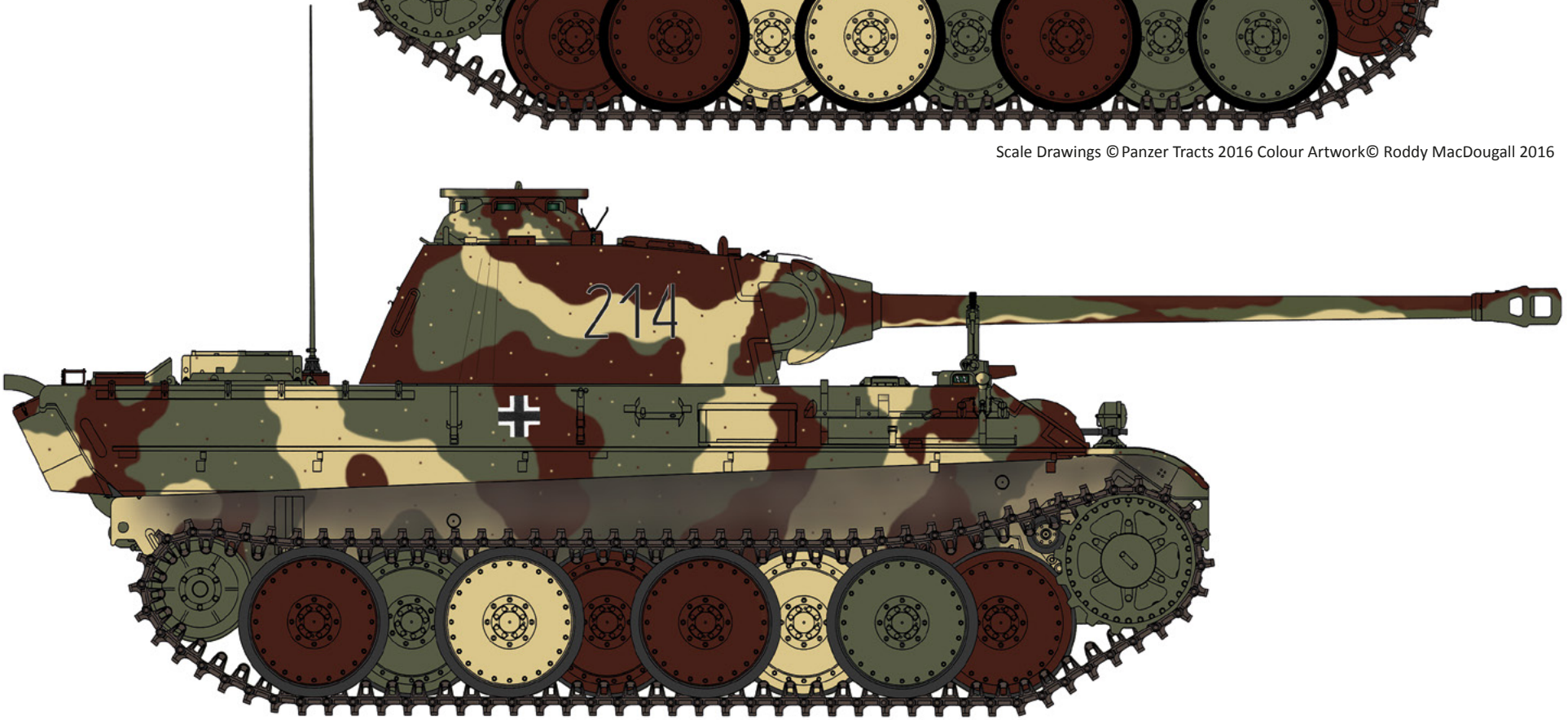

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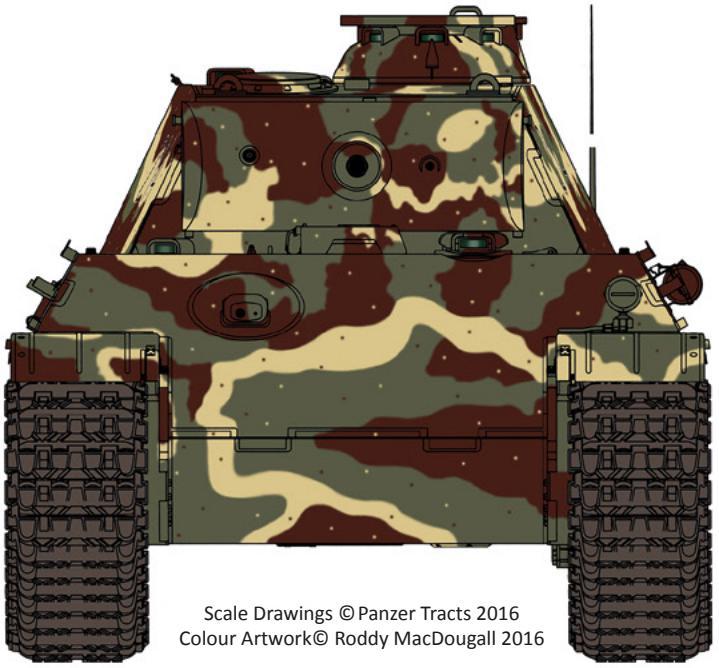

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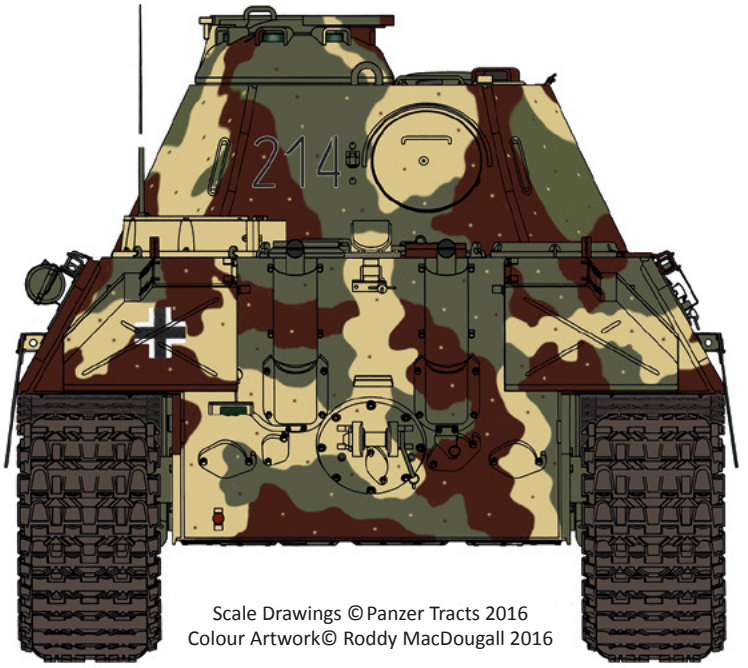

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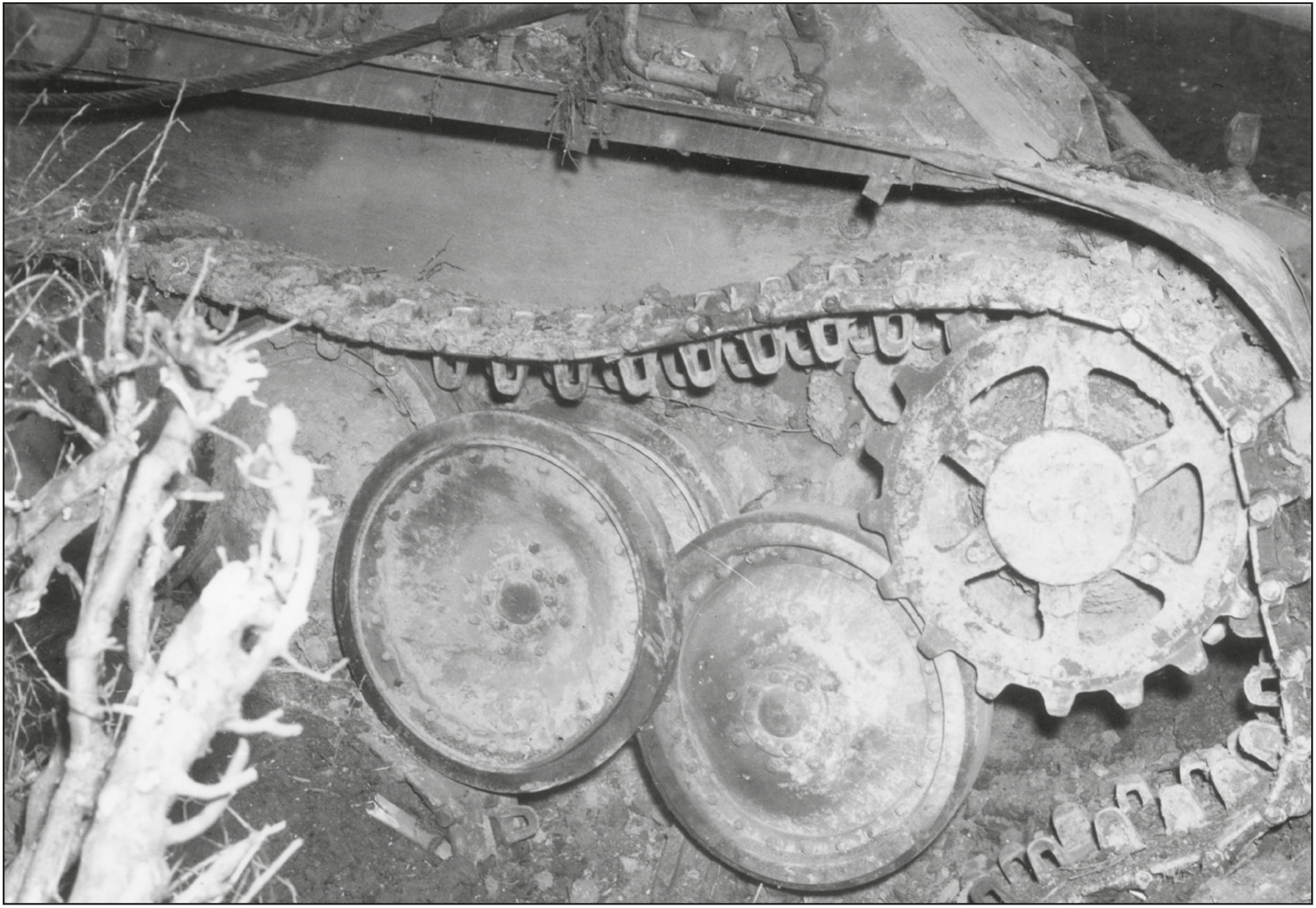
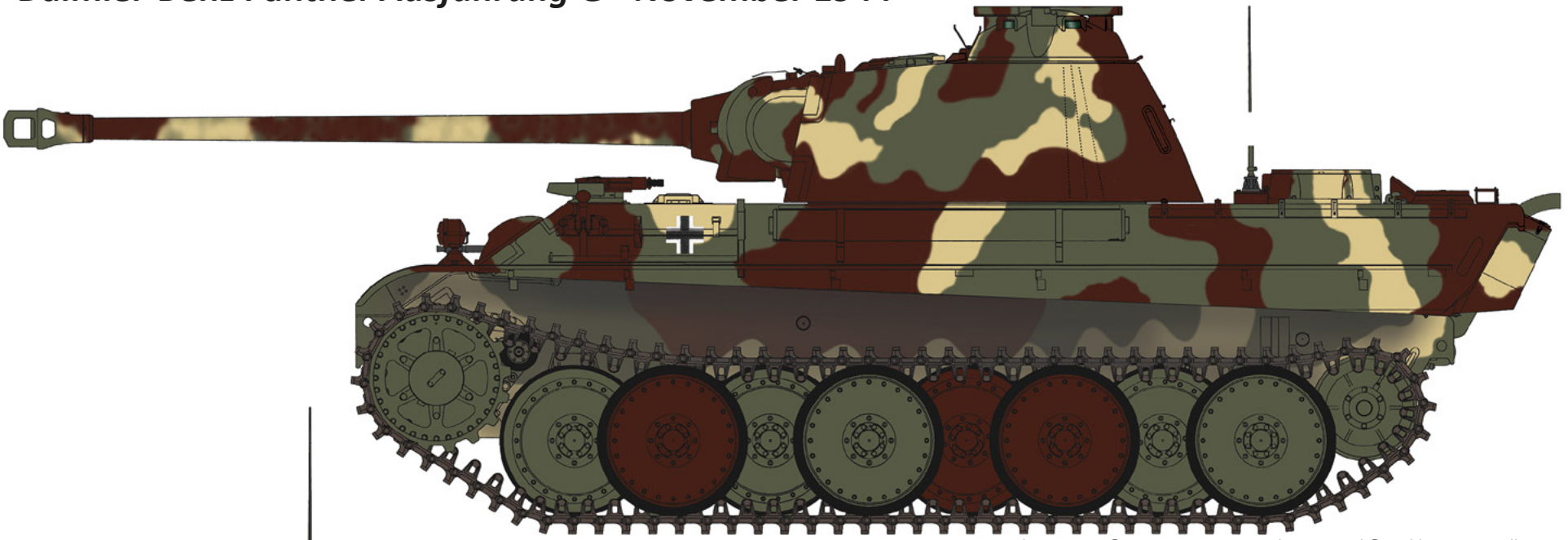
Panther *Fgst.Nr.* 124830 was completed on or about 18th October at the Daimler-Benz Werke 40 at Berlin Marienfelde. It was then issued to 2./SS-Pz. Rgt. 2 in November 1944 where it served in the 1st Platoon. It took part in the Ardennes Offensive and was abandoned after running over a mine in the meadow north west of the entrance to Grandmenil on the N807. It now serves as a war memorial a few hundred meters further down the road in the centre of Grandmenil following its recovery. There are numerous photographs of this vehicle that span a period from a few hours after its loss to the present day, this has enabled us to establish the build features present and the camouflage scheme used on this vehicle when it was completed by Daimler-Benz. It has been painted in the "Classic" standardised *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme used by Daimler-Benz from early September 1944 up to April 1945 with the contrasting spot overlay that was unique to Daimler-Benz Panther assembled from early September until it was discontinued towards the end of October 1944. A colour photograph of this Panther taken in the late 1940's shows that this Panther was given an overall coat of *Dunkelgelb* RAL 7028 prior to the application of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017, areas that could clearly be seen in these colours on earlier photographs had worn showing the Dunkelgelb RAL 7028 underneath. We have chosen to show the tactical number present when this Panther was abandoned on the colour plates above and to the left in the hope that these will be accurately reproduced when this Panther is repainted at some point in the future. This Panther was fitted with the 600mm diameter *Leiträder* (idler wheels) that Daimler- Benz fitted to all of the Panthers they completed from the start of series production. It also has the forged armoured exhaust elbows that Daimler-Benz had just started to fit to completed Panthers. The stowage bracket for the track changing cable had been installed vertically on the starboard side of the *Fahrgestell* by both Daimler-Benz and M.N.H. on all of the *Ausführung* G Panthers they had completed up to early August after which it was welded horizontally by all of the assembly firms.

Panther tactical number 101 was Ostuf. Karl Kremser's vehicle, he commanded 1./SS-Pz.Rgt. 1 until he was wounded in Stavelot on 18th December 1944. He had a great deal of experience in armoured warfare and it is interesting that he chose to mount the rows of spare tracks used as additional armour on the Turm sides with the guide horns facing the armour plate. His Panther was completed between September and late October by Daimler-Benz in the "Classic" factory applied camouflage pattern with contrasting spot overlay. This was not applied to the 7.5cm Kw.K.42 L/70 main gun, the light marks that can be seen on the gun barrel are the result of damage caused by shell splinters and or small arms fire. The *Dunkelgelb* RAL 7028 lobes on the port side of the gun mantle and to the upper starboard side of the Kugelblende ball mount that are a feature of this camouflage pattern are both evident in this photograph. (Freddy Lemaire LUMA)



This photograph of Ostuf. Karl Kremser's Panther was taken with a flash to illuminate the lower *Fahrgestell* underneath the sponson and running gear. The camouflage pattern applied to the lower *Fahrgestell* can be made out clearly and shows this Panther also had the contrasting spot overlay applied to the *Fahrgestell* sides behind the running gear. Photographic evidence confirms that the contrasting spot overlay was not applied to the lower *Fahrgestell* sides of all of the Panthers completed with this camouflage scheme between September and October 1944. (NARA via Darren Neely)

Daimler-Benz Panther *Ausführung* G - November 1944



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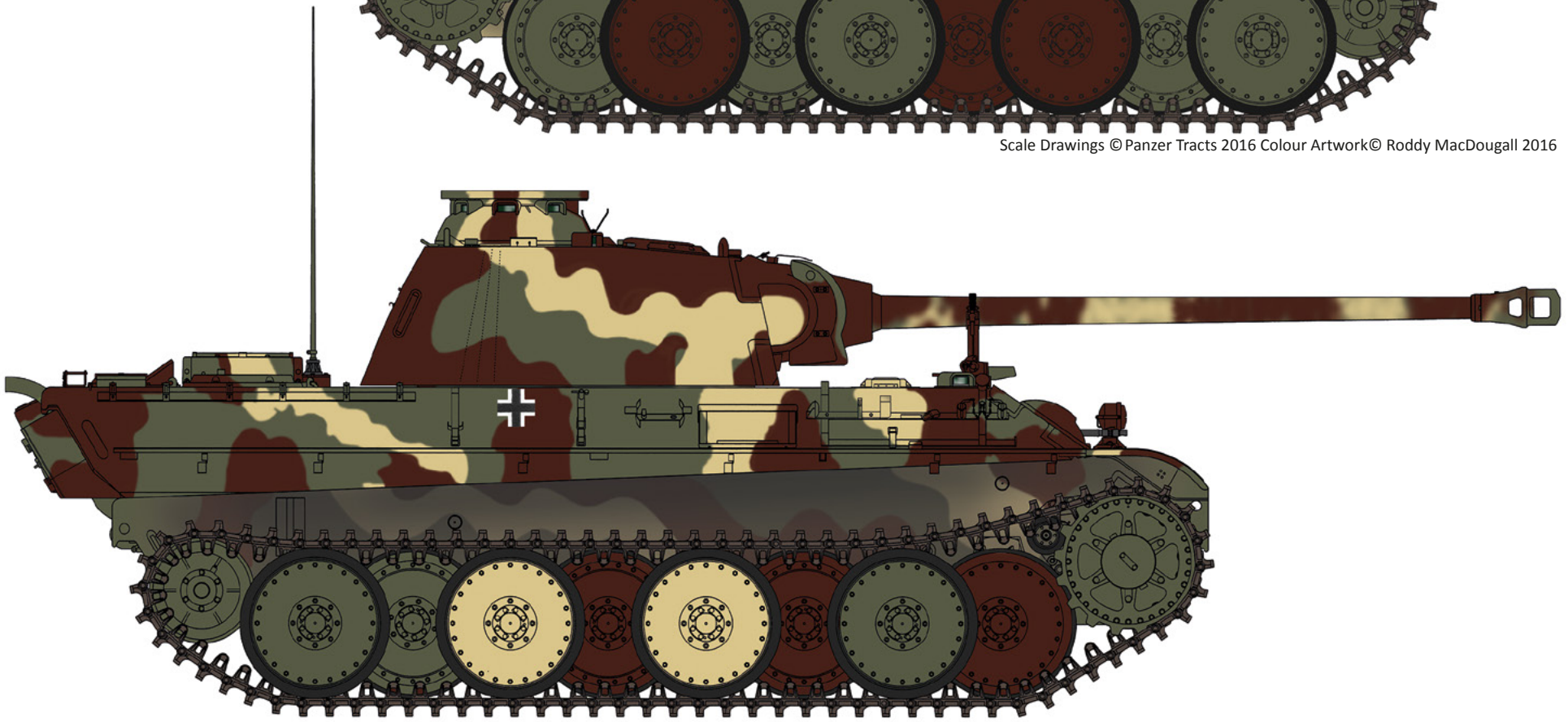

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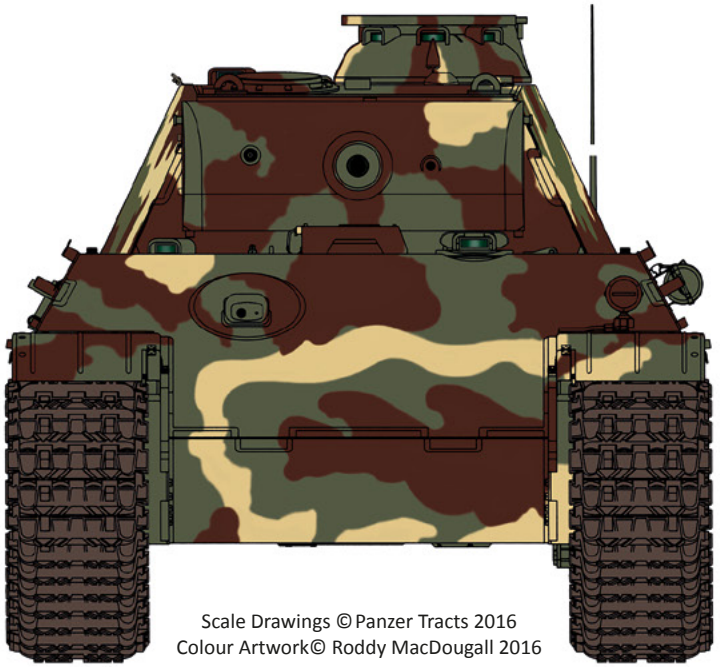

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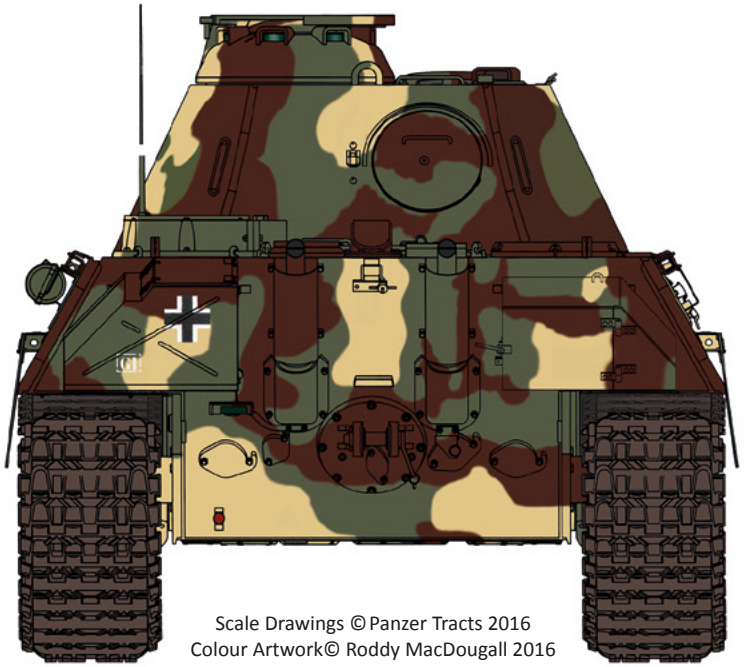

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This Panther was painted in the "Classic" standardised *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme used by Daimler-Benz from early September 1944 up to April 1945. Daimler-Benz would no longer apply the contrasting spot overlay to the Panthers they completed from the end of October on. This vehicle was completed in November and has been fitted with a strengthened "Chin" gun mantle (021 St 50258) which had just been introduced and was now being fitted to a large number of Panthers that were completed each month at Daimler-Benz's Werke 40. This new mantle would never completely replace the older "round" design (021 St 50255) which could be found on new Panthers being delivered to the *Wehrmacht* right up to the end of the war. The *Dunkelgelb* RAL 7028 lobe painted above the *Kugelblende* is further over to the starboard side on Daimler-Benz vehicles rather than directly above it. This Panther has received some preparation for service with I.R. night vision equipment. The external changes made included the replacement of the starboard *Gepäckkasten* with an armoured stowage box. Daimler-Benz and M.N.H. would mount the box so that its lower edge aligned with the bottom of the sponson. The mounting points for a weatherproof 4 pin Bosch lamp socket plate used for an I.R. lamp were welded to the starboard side of the gun mantle. The vehicle's 7.5cm Kw.K.42 L/70 gun was delivered from the sub contractor finished in a coat of grey heat resistant lacquer it was then camouflaged with loosely sprayed bands of *Dunkelgelb* RAL 7028 and *Rotbraun* RAL 8017 paint leaving large areas of the grey lacquer visible. There are almost no photographs that show post September Panthers completed by either Daimler-Benz or M.N.H. with a *Dunkelgelb* RAL 7028 muzzle brake. This Panther was issued to I./Pz.Rgt. 3 and would be abandoned at the railway marshalling yard at the Waldhof district of Mannheim in the German state of Baden Württemberg. This Panther had the letters "GI" surrounded by a rectangle stencilled with white paint on the starboard *Gepäckkasten* indicating the vehicles coolant had been treated with *Glysantin*. The use of *Glysantin* and its associated markings are discussed in detail in the chapter 9. The *Turm* roof has an aperture for the gun elevation control tape that is protected by an armoured horseshoe welded in front of the commander's cupola, the handle on the hatch of the cupola was removed on I.R. prepared Panthers but not all of those that had only been partially equipped for use with this equipment. There was some considerable time lag between the *Heeres-Waffenamt* issuing orders instructing the assembly plants to complete Panthers with components intended for use with I.R. equipment and the subsequent orders countermanding these instructions as the design of the FG 1250 had not been finalised. This resulted in a number of vehicles being accepted for service with the *Wehrmacht* that were partially equipped with components that were compatible with the earlier designs for the FG 1250 that would eventually see front line service with the *Panzerwaffe*.

This Panther was painted in the "Classic" standardised *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme by Daimler-Benz in November 1944, the contrasting spot overlay had been discontinued in October. A *Dunkelgelb* RAL 7028 lobe painted above the *Kugelblende (MG ball mount)* on the glacis plate can just be made out. This Panther does not have *Flammenvernichter* (flame suppressing exhausts) fitted, Daimler-Benz would not fit these until early December 1944. It has been fitted with a new strengthened " Chin" gun mantle (021 St 50258) that Daimler-Benz had just introduced to series production Panthers in November. A Bazooka round has penetrated the armour plate on the front corner of the *Turm*. (NARA via Darren Neely)

This Panther was completed "Classic" standardised *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme by Daimler-Benz in December 1944 and issued to I./Pz.Lehr-Rgt. 130 in early February 1945. It has been fitted the spare wheel brackets on the turret rear quarters and has had the starboard side Balkenkreuz painted to the rear of the 5k hammer stowage brackets. The unit *Werkstatt* have fabricated hooks for carrying additional spare tracks as supplemental armour on the turret sides. The starboard side spare wheel bracket is preventing the rear row of tracks from lying flat against the *Turm* armour. It would appear that the vehicle has run over a mine causing damage to its *Kettenantriebsrad* (drive sprocket) and the first set of road wheels. The "R" marking on the glacis plate indicates the direction of the *Rückmarsch* (retreat) to any units withdrawing from the front lines. (NARA via Darren Neely)

Daimler-Benz Panther *Ausführung* G - December 1944

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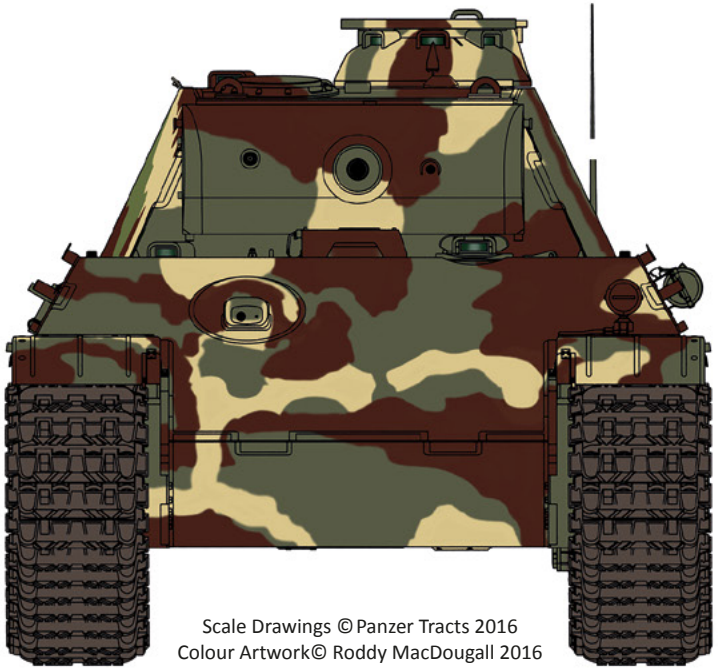

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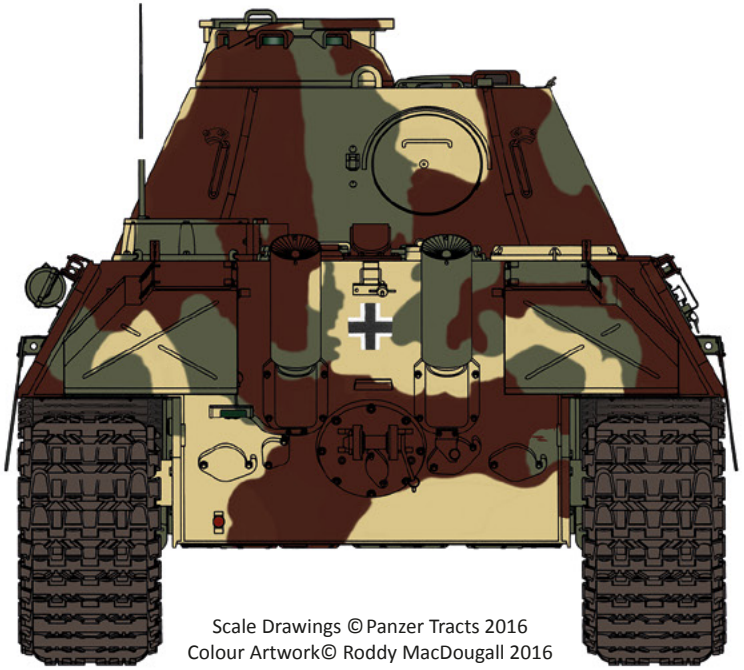

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This Panther was painted in the "Classic" standardised *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme used by Daimler-Benz from early September 1944 up to April 1945. A *Dunkelgelb* RAL 7028 lobe painted above the *Kugelblende* is slightly off centre on this particular vehicle, this is usually further over to the starboard side on Daimler-Benz Panthers rather than directly above it. Daimler-Benz would install *Flammenvernichter* on all of the Panthers they completed from early December on to the end of the war. The chamfered section of the starboard side trunnion armour, just behind the gun mantle has a *Rotbraun* RAL 8017 border around most of it that is a continuation of the *Rotbraun* RAL 8017 colour field on the *Turm* side. This borders the diagonal *Dunkelgelb* RAL 7028 stripe on the starboard sides of the *Turm*. There is *Dunkelgelb* RAL 7028 counter shading on the lower surface of 7.5cm Kw.K.42 L/70 main gun, although this is a typical feature of the standardised "Classic" factory applied camouflage scheme it is not always present. The *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage on the lower *Fahrgestell* behind the running gear is typical of Daimler-Benz Panthers and frequently does not match the colour fields on the *Fahrgestell* sides above it. The Antennen were supplied complete and painted by a sub contractor, the colour used varied in accordance with the purchase contract issued by the *Heeres-Waffenamt* to the firms supplying this component. This Panther has a set of brackets welded to the *Turm* sides at the top of the rear plate interlock for carrying spare road wheels. This feature is unique to Panthers assembled by Daimler-Benz and was fitted to all of the Panthers completed by them from early December 1944 to the end of the war. Daimler-Benz had applied the *Balkenkreuze* to the port side *Gepäckkasten*, in the centre of the wire cutter tool stowage bracket on the port side of the *Fahrgestell* and centrally between the hammer tool stowage brackets on the starboard side of the *Fahrgestell* since the start of *Ausführung* G production. The Panthers issued to I./Pz.Rgt. GD in December 1944 were the first Panthers completed by Daimler-Benz to have the port side *Balkenkreuz* applied to the Fahrgestell just behind the gun cleaning tools tube. The rear *Balkenkreuz* was moved from the starboard *Gepäckkasten* to the middle of the rear *Fahrgestell* on these Panthers and was almost completely obscured by the vehicle's jack when stowed. The side *Balkenkreuze* could be painted underneath the first row of spare tracks hung from the brackets on the *Fahrgestell* side or on the side of the *Turm*. A number of these vehicles still had the starboard *Balkenkreuz* between the two tool stowage brackets for the sledge hammer. The change in the location of the *Balkenkreuze* should be seen as an alternative placement from the middle of December 1944 on, as Daimler-Benz would still complete a number of Panthers with the national markings applied in the "standard" locations that were used when Diamler-Benz started production of the *Ausführung* G series.

Panther tactical number 321 from 3./Pz.Lehr-Rgt. 130 was completed by Daimler-Benz in mid to late December 1944. It has been fitted with the brackets designed to carry spare road wheels welded to the *Turm* rear quarter. This was welded over the forward weld seam on the *Turm* rear plate interlock and can be seen here carrying a spare road wheel. The *Pilz* (mushroom) socket visible on the *Turm* roof still has the domed cap fitted that resembled a mushroom and gave this socket its name. This Panther is fitted with 600mm diameter *Leiträder* (idler wheels), Daimler-Benz would not fit the larger diameter self cleaning idler wheel to any of the *Ausführung* G Panthers they completed. This Panther is painted in the *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 standardised "Classic" factory applied camouflage scheme, the Olivgrün RAL 6003 spare road wheel on the *Turm* quarter has had splotches of *Rotbraun* RAL 8017 and *Dunkelgelb* RAL 7028 applied in an attempt to break up the shape. (Crown BHC)

Above and next page: Panther tactical number 323 from 3./Pz.Lehr-Rgt. 130 was also completed by Daimler-Benz in mid to late December 1944. The brackets designed to carry spare road wheels on the *Turm* rear quarter are preventing the row of spare tracks from lying flat on the *Turm* armour. Both front fenders have been lost and the *Schürzen* rail is damaged. This Panther is painted in the *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 standardised "Classic" factory applied camouflage scheme. The starboard trunnion armour on the cast front plate of the *Turm* on both Panther 321 and 323 have a *Rotbraun* RAL 8017 border leaving *Dunkelgelb* RAL 7028 on the raised cheek section. The *Balkenkeuze* national marking on the *Fahrgestell* sides have ben applied so that when the spare tracks are mounted they obscure these markings. Both photographs of Panther 323 afford an excellent view of the redesigned tubular levers and hinges (Drawing PV-G 520) on the driver and radio operators hatches. Panther 323 has been issued with the small jack block intended for use wth the *Ausführung* D and A series. (2 x Signal Corps via Darren Neely)

M.N.H. FACTORY APPLIED CAMOUFLAGE PATTERNS

This Panther *Ausführung* G was one of the first Panthers completed by M.N.H with a full coat of *Zimmerit* paste and finished in the newly introduced RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 standardised factory applied camouflage scheme with a "Disc" pattern overlay around 20th August 1944. It is one of at least 5 Panthers completed by M.N.H with this new camouflage scheme that was issued to I./Pz-Lehr.Rgt. 130 on 24th August, when they were attached to Pz.Brig. 113 in the Lorraine region of France. It has had a large section of the Turm side over painted in *Dunkelgelb* RAL 7028 to allow a new tactical number to be painted following the debacle at Dompaire where Pz.Brig. 113 were decimated by Allied forces which necessitated some tactical reorganisation. It was subsequently knocked out in the vicinity of Parroy which is approximately 2km east of Bures. (NARA via Darren Neely)

The majority of the original German documentation that survived the war was found at the M.N.H. assembly plant at Hanover, however there are no factory photographs taken at the M.N.H. plant showing the introduction of new features or camouflage schemes known to have survived the war. This series of photographs are stills taken from the cine film shot when Panther tactical number 252 was recovered by Allied troops from the fields around Parroy in October 1944. There are very few occasions when three sides of the same M.N.H. assembled Panther are available and that were photographed on the same day. The ridged surface texture can be seen to good effect, it has a remarkable similarity to the ridged surface texture on the *Zimmerit* paste found on Panthers and Bergepanthers completed by Demag as seen on pages 87-89. A close examination of both types of texture surface reveal that there are subtle differences in the techniques used to form the ridges that increase the depth from the surface of the *Zimmerit* to the armour below. With the exception of the *Gepäckkasten,* none of the sheet metal components have had a coating of *Zimmerit* paste applied by the assembly plant. The welded armoured exhaust elbows have been coated with *Zimmerit* paste as well as the edges of the armour plates on the lower *Wanne* sides which is quite unusual on a Panther completed by M.N.H. The exhaust stacks and jack stowage bracket are connected by sheet metal braces, the use of these braces was discontinued by M·A·N in June and Daimler-Benz in July. (4 x NARA via Bill Auerbach)

M.N.H. Panther *Ausführung* G - August 1944

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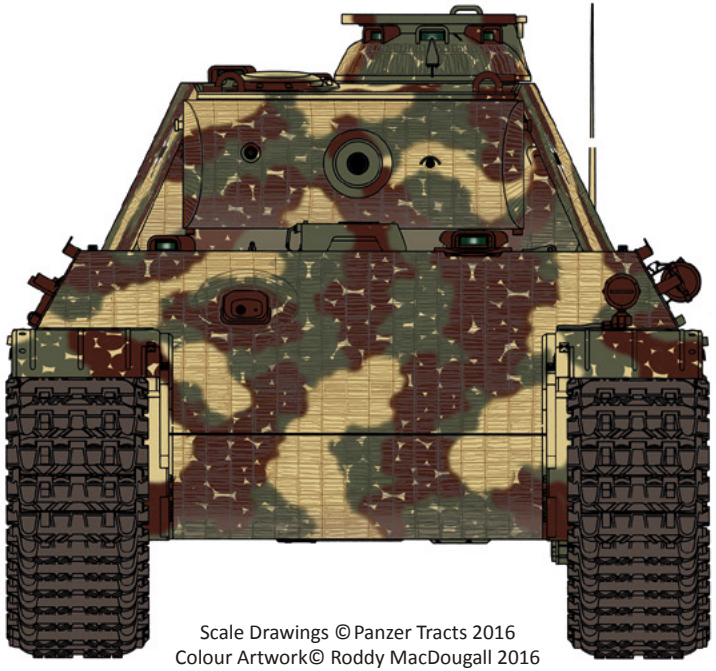

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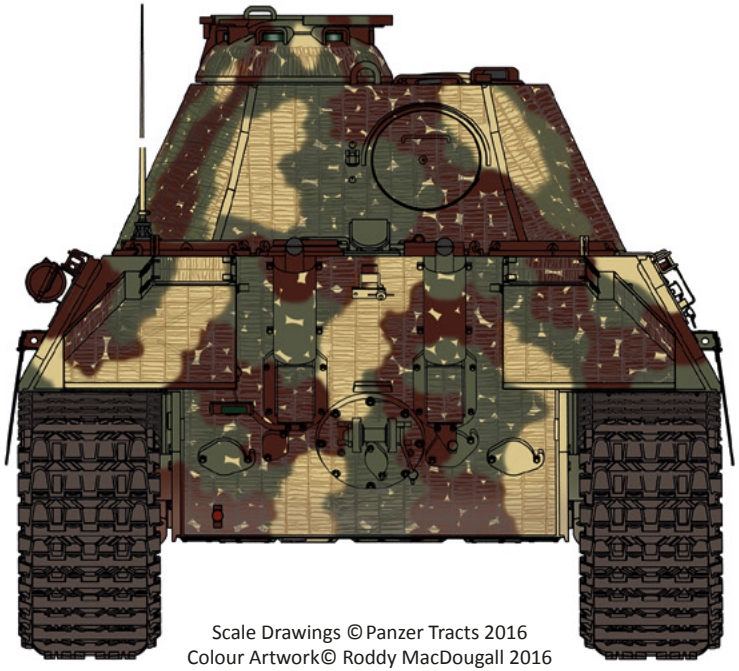

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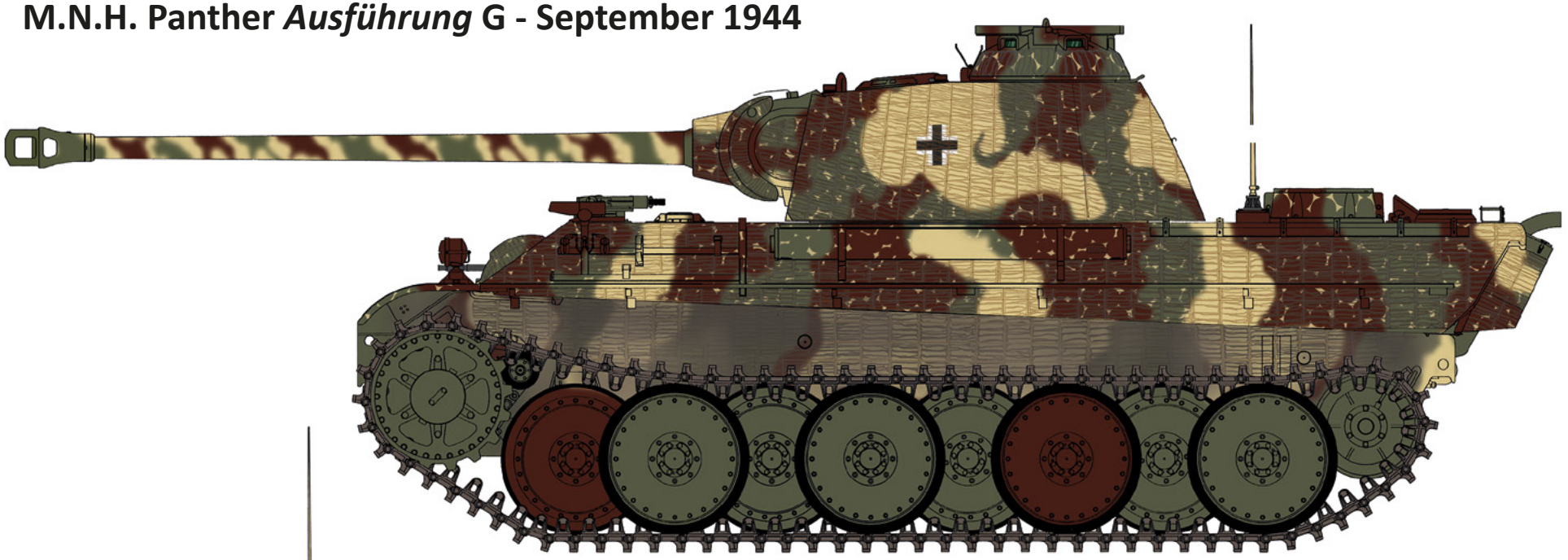
In an attempt to overcome the considerable air threat that was prevalent on all fronts, economise valuable resources, streamline production and provide vehicles to the German *Panzerwaffe* that were available for immediate combat, German armoured vehicles were to have effective, standardised camouflage paint schemes applied at the assembly plants. These camouflage schemes were developed by the *Heeres-Waffenamt* who would send out *Tarnbilder* (templates) for the particular schemes that the individual assembly plants were to implement. Instructions were issued to the assembly firms to apply the camouflage pattern at the assembly plant with *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 spray painted in patches over the *Dunkelgelb* RAL 7028 base coat. This order created the camouflage pattern which has become widely known as the "Ambush" or "*Licht und Schatten*" camouflage scheme. We can see how this order was implemented by both M·A·N and M.N.H. after the 19th August from the sequence of Panthers from Pz.Brig.111 photographed at Bures in the Lorraine region in September 1944 and the vehicles issued to I./Pz.Rgt. 29 while it was attached to Pz.Brig.112. We can now see that larger areas of the Panthers are covered in green and red brown in comparison to the trial run batch. A prominent feature on these Panthers is the application of a "Disc" camouflage overlay in *Dunkelgelb* RAL 7028 which made up the "Ambush" element of this pattern. This was applied using a stencil mask made up with different sizes of discs connected together at the edges. There were typically 3 different sizes of discs used to create each stencil. The discs were arranged so that the left and right hand sides of the pattern could interlock which resulted in a repeating pattern that looked as though it had been applied with a roller or the repeating pattern on wallpaper. This was not always done, however when the pattern has not been interlocked properly it is not a reflection of the stencils ability to do so if used properly. There were clearly instructions on how to create the stencils issued to the assembly firms, it is worth noting that there are several minor variations to the size and placement of the discs used to create the stencils so that subtle differences can be seen between different vehicles. This overlay was accompanied by meandering bands or areas of *Dunkelgelb* RAL 7028 randomly applied with a spray gun over the vehicle. The 7.5cm Kw.K.42 L/70 main gun was camouflaged with alternating bands of *Olivgrün* RAL 6003, *Dunkelgelb* RAL 7028 and *Rotbraun* RAL 8017 spiralling round the barrel over the heat proof lacquer paint applied at the sub contractor who manufactured this component's premises.

This Panther *Ausführung* G tactical number 113 was one of several Panthers completed by M.N.H. with a full coat of *Zimmerit* paste that includes the commanders cupola as well as the two *Gepäckkasten* stowage boxes mounted on the rear plate of the *Fahrgestell.* This Panther was finished in the newly introduced *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and Rotbraun RAL 8017 standardised factory applied camouflage scheme with a "Disc" pattern overlay in August 1944. The camouflage pattern consisting of alternating spirals or bands of *Olivgrün* RAL 6003, Rotbraun RAL 8017 and or *Dunkelgelb* RAL 7028 would be applied over the heat resistant lacquer on the 7.5cm Kw.K.42 L/70 main gun. *Balkenkreuze* national markings have been applied to both sides of the turret but not to the *Gepäckkasten.* It is one of several Panthers completed by M.N.H. with this new camouflage scheme that were issued to I./Pz.Rgt. 29 between 3rd and 5th September 1944. I./Pz.Rgt. 29 were attached to Pz.Brig. 112 in the Lorraine region of France and were almost completely wiped out when they lost 34 Panthers in and around the town of Dompaire between 12th and 14th September. Panther tactical number 113 is shown being inspected by troops from the French 2ième Division Blindée (2nd Armoured Division) after they had liberated the town. (2 x NARA via Bill Auerbach)

M.N.H. Panther *Ausführung* G - September 1944



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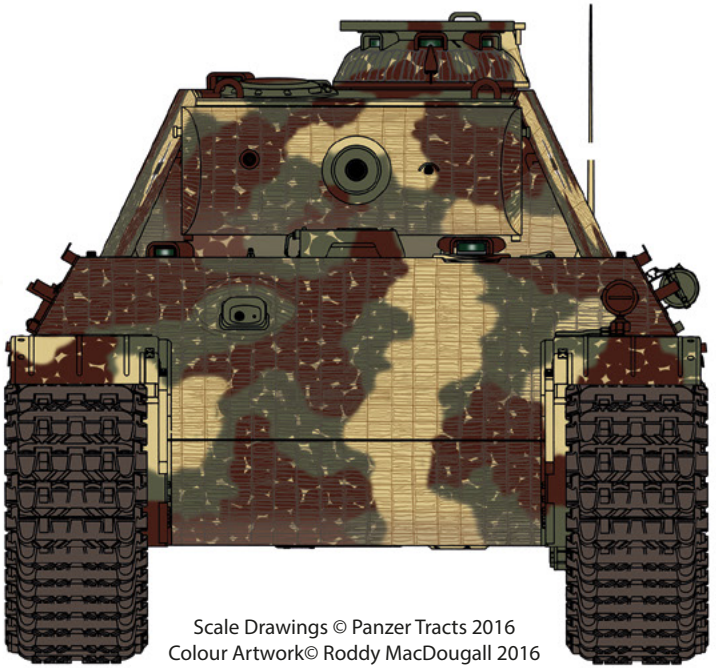

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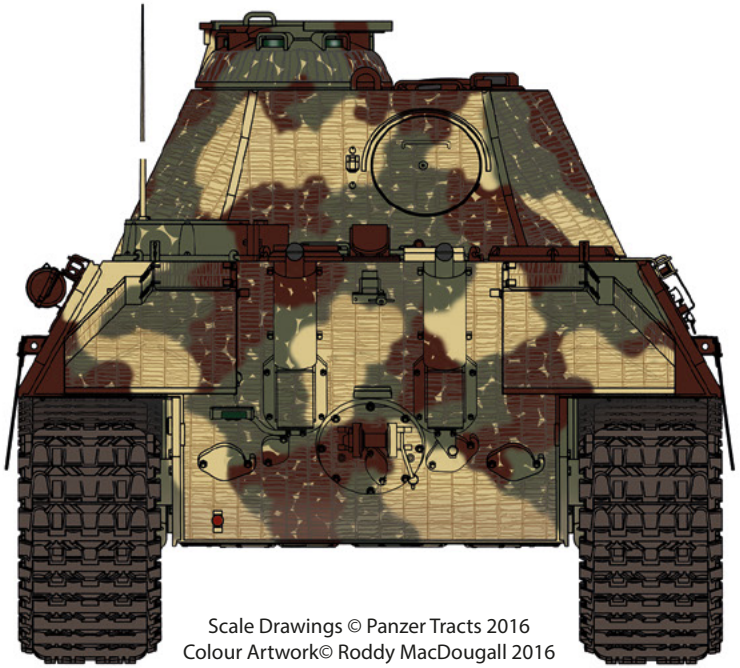

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The General Order dated 19th August 1944 sent to all of the assembly plants involved in the Panther programme stated that "all Panthers were to be painted with a standardised camouflage pattern prior to being shipped from the assembly plants". The development of standardised camouflage patterns saw factory applied camouflage schemes officially introduced on 19th August 1944. Instructions were issued to the assembly firms to apply the camouflage pattern at the assembly plant with *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 spray painted in patches over the *Dunkelgelb* RAL 7028 base coat. This order created the camouflage pattern which has become widely known as the "Ambush" or "*Licht und Schatten*" camouflage scheme. The scheme had not changed and was still being used by M.N.H. on the Panthers it completed in September 1944. It was applied over the top of the distinctive coating of *Zimmerit* anti magnetic paste as seen on this Panther issued to I./SS-Pz.Rgt. 9 prior to this being discontinued later in September. The M·A·N and M.N.H. assembly plants no longer applied a coat of *Zimmerit* paste to the front fenders of the Panthers they completed from the end of August. This vehicle is one of the earliest examples of a series production Panther completed with a *Warmluftbeheizung* (warm air heater) fitted to the engine deck. One of the other Panthers completed with a *Zimmerit* coating, "Disc" camouflage and fitted with a *Warmluftbeheizung* that was issued to I./SS-Pz.Rgt. 9 on 19th September was knocked out a few days later on 23rd September 1944 by British forces on the outskirts of Elst in Holland. M.N.H. would also be one of the first assembly firms to complete Panthers with the forged armoured exhaust elbows in late August 1944. A smaller stencil section was used to apply the disc element of the camouflage scheme on the cupola and *Warmluftbeheizung*, this repeats more noticeably than larger stencilled sections of the vehicle. The "Ambush" or "*Licht und Schatten*" element of the camouflage was not applied to the areas that were painted prior to the installation of the Panther's running gear by any of the assembly firms. The barrel of the 7.5cm Kw.K.42 L/70 main gun has been camouflaged with alternating bands of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 loosely spray painted over the *Dunkelgelb* RAL 7028 heat resistant lacquer leaving some of the lacquer exposed. The fact that vehicles painted these camouflage schemes are similar but are not identical was intentional. It would be very difficult and extremely time consuming to apply these schemes so that the vehicles painted in them were completely identical to each other. If this had in fact been done then the fact that the vehicles were completely identical would create its own problems in that a column of vehicles would have a repeating pattern that was particularly noticeable to air reconnaissance. This would defeat the main purpose behind the introduction of these schemes, protecting these valuable assets from air attack.

This Panther *Ausführung* G was completed with a full coat of *Zimmerit* paste and standardised factory applied "Disc" camouflage in September 1944. It was one of at least three Panthers finished in this camouflage scheme issued to I./SS-Pz.Rgt. 9 on the 19th September. Eight of these Panthers were unloaded at Bocholt near the Dutch border and were subsequently attached to I./SS-Pz.Rgt. 10, who had no Panthers at that time, and in turn to *Kampfgruppe* Knaust. This is the earliest series production Panther identified to date with a *Warmluftbeheizung* (crew compartment heater). The dispatch rider Gunner Dillwyn James R.A. 944109, was photographed beside this Panther in November 1944 while he was attached to the 49th (West Riding) Inf Div. (John Stubbs via Lee Archer)

Troops from 1./Pz.Rgt. 1 picked up 20 new Panthers on 11th September 1944 including this Panther completed a few days earlier by M.N.H. It has been given the tactical number 100 and the name "Oswin" is painted in white on the 7.5cm Kw.K.42 L/70 main gun. It has a full coat of *Zimmerit* paste that was textured using a spatula tool similar to a trowel or float. The highlights and shade created by the textured surface help break up the pattern created by the Dunkelgelb RAL 7028 "Disc" camouflage overlay. This view of the *Fahrgestell* roof enables us to see that there is no *Belüftungspilz* (domed cap) underneath the ventilator's armoured cover. The assembly firms were instructed not to fit this for a short period in July before M.N.H. had reported to the *Heeres-Waffenamt* that it had recommenced installing these in July, however there were clearly difficulties in obtaining supplies of this component. This Panther has the later pattern of *Feuerlöscher* (Fire Extinguisher) that came with a stowage bracket that has a single securing strap. (Darren Gawle)

M.N.H. Panther *Ausführung* G - September 1944

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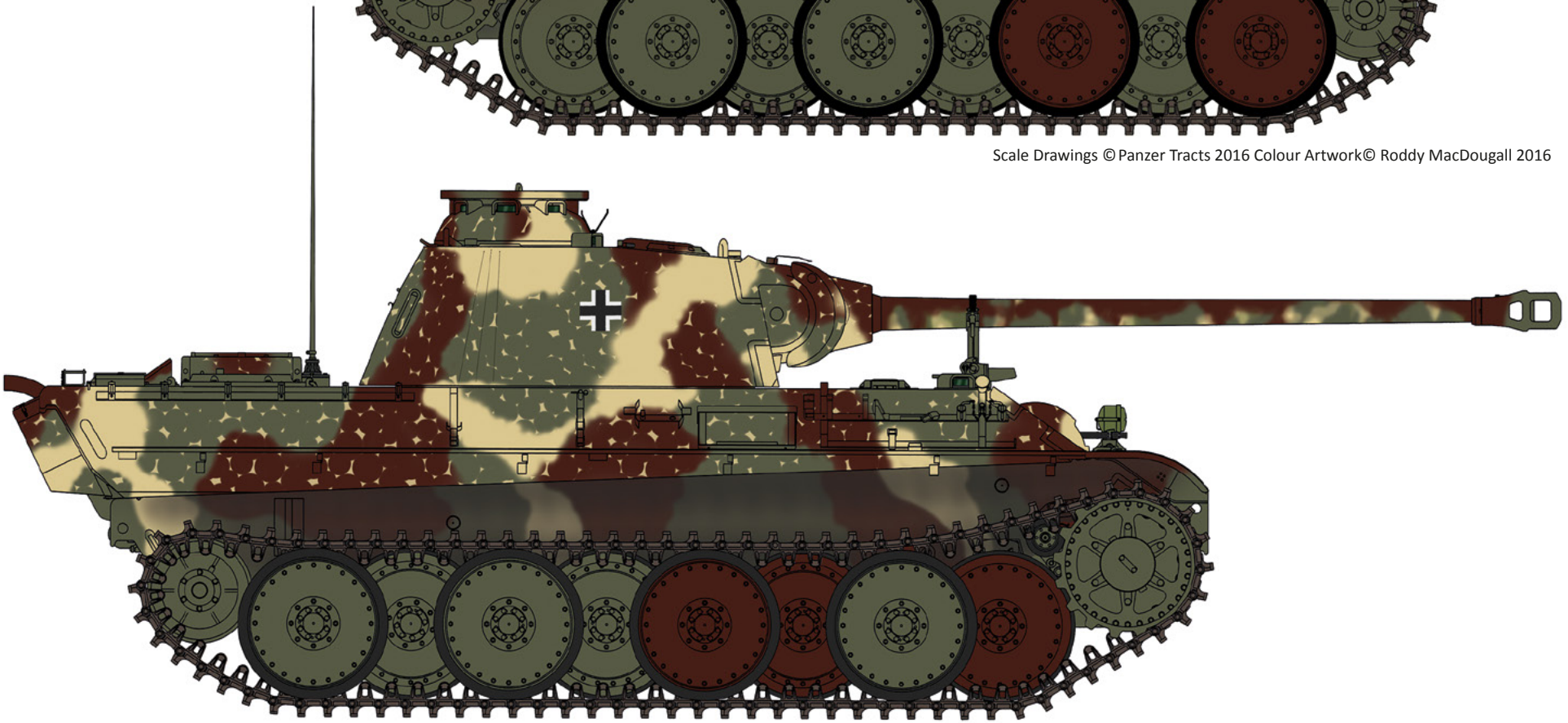

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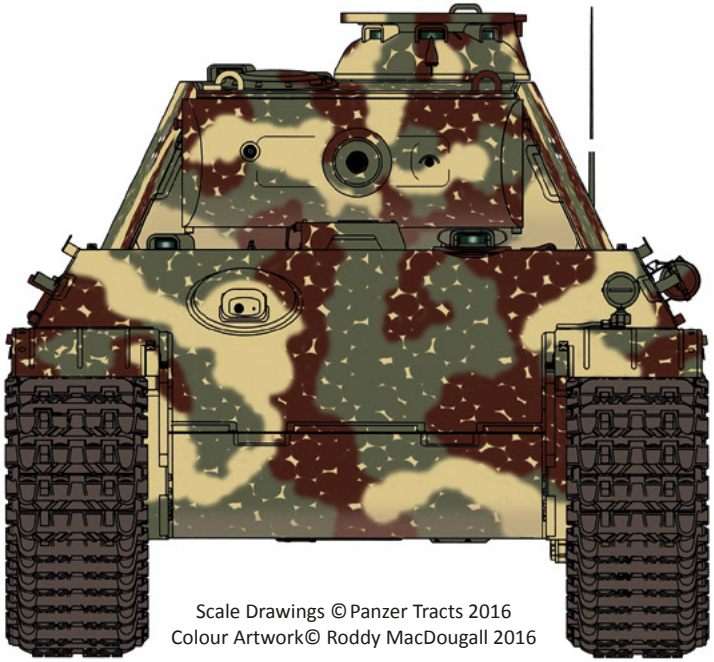

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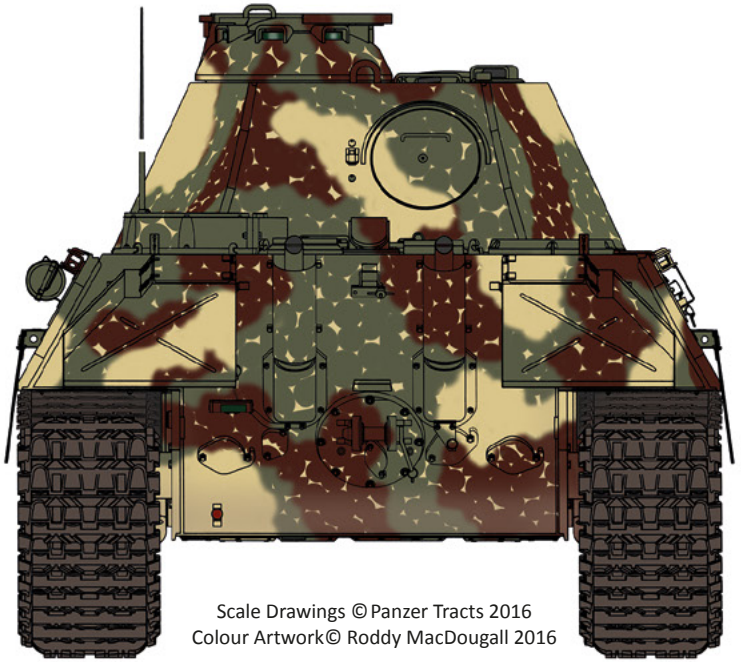

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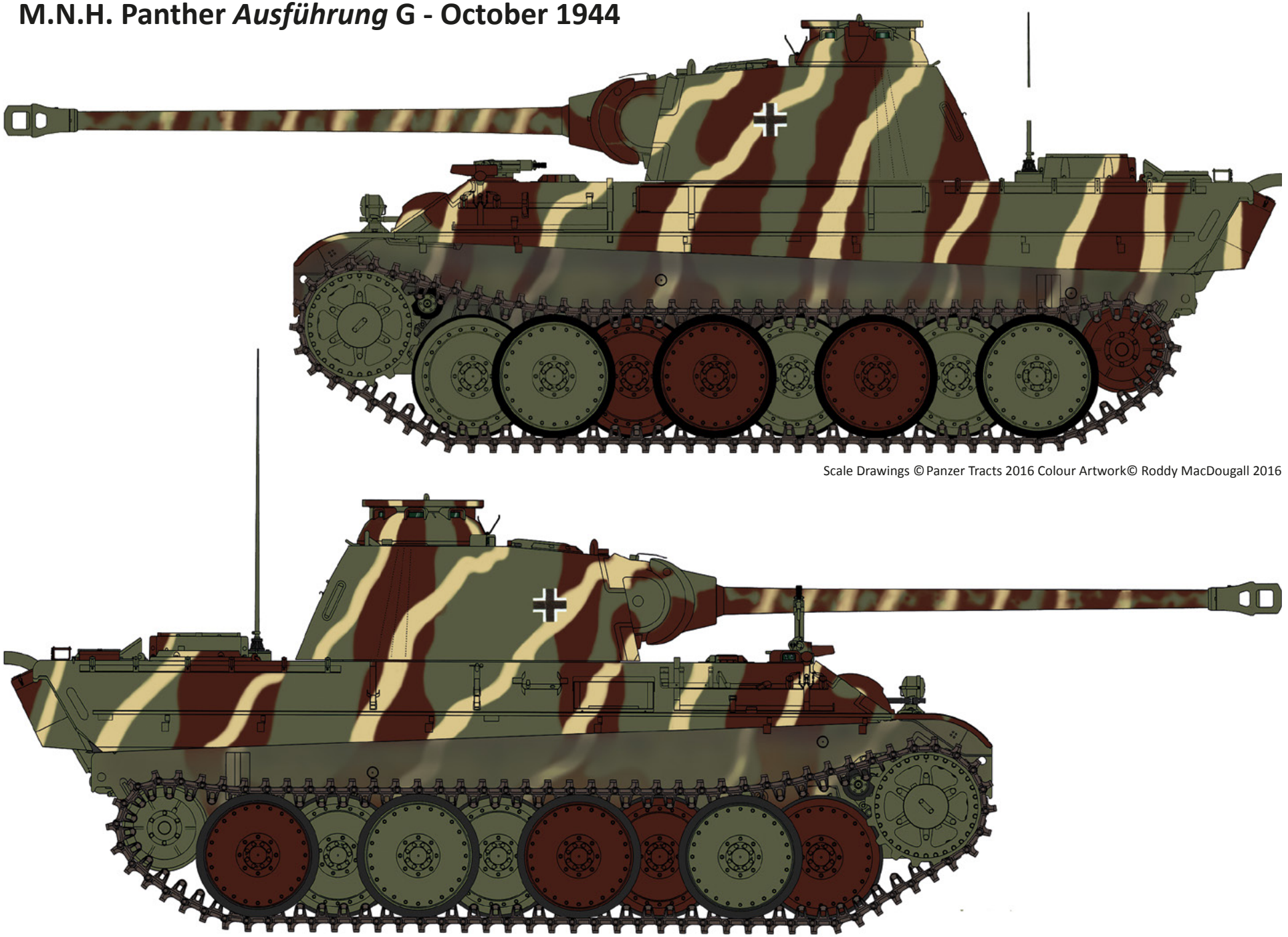
The instruction to discontinue the application of *Zimmerit* anti magnetic paste was issued to the assembly firms by *Wa Prüf 6* to the assembly plants on 9th September 1944. This distinctive coating was rumoured to be the source of vehicle fires following shell strikes on the armour resulting the *Generalinspekteur der Panzertruppen* deciding at a meeting on 7th September to order its discontinuation. The assembly plants typically coated major components with *Zimmerit* prior to final assembly so that a number of Panthers were completed by M·A·N and Daimler-Benz with *Türme* that had already been given a full or partial coat of *Zimmerit* prior the instruction to discontinue its application being received but no *Zimmerit* on the *Fahrgestell*. When M.N.H. received the order to discontinue the application of *Zimmerit* paste on 9th September they would seek clarification from the *Heeres-Waffenamt* regarding what to do with vehicles that were in the process of having a coating of *Zimmerit* applied when the instruction to cease its application was received. They were instructed by the *Heeres-Waffenamt* to apply a *Zimmerit* coating to the *Fahrgestell* and sub components and complete these vehicles as normal. A list of the last vehicles to receive this coating was supplied to the *Heeres-Waffenamt* by M.N.H. on 19th September 1944 which read, "We have the following vehicles in the process of assembly that have received a protective coating: 128562 to 128565, 128568 to 128569, 128572 to 128 579, 128581, 128583 to 128593 and from 128595 continuously would be completed without *Zimmerit*". The "Disc" camouflage scheme was still being applied to Panthers completed by M.N.H. after the discontinuation of *Zimmerit* paste, M.N.H. would continue to complete series production Panthers in this scheme up to the last week to ten days of October 1944. The intermediate design of strengthened gun mantle was used on a number of the Panthers completed by M.N.H. up to the end of October as was the case with this Panther from 1./SS-Pz.Rgt. 1. This Panther was given the tactical number 114 and left behind in the village of La Gleize in Belgium when *Kampfgruppe* Peiper abandoned all of its vehicles and withdrew from the village on 24th December 1944. The road wheels were painted in a single colour and were then randomly fitted so that there is no set number of wheels in either *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 or *Rotbraun* RAL 8017 on any one vehicle. Having said that period photos show a high percentage of Olivgrün RAL 6003 or *Rotbraun* RAL 8017 wheels fitted to Panthers completed after the introduction of factory applied camouflage schemes on 19th August 1944.

Panthers tactical number 114 and 131 were issued to 1./SS-Pz.Rgt. 1 in October 1944 and were subsequently lost at La Gleize (above) and Cheneux (opposite page) during the Ardennes offensive. M.N.H. would continue to use the same *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme with a *Dunkelgelb* RAL 7028 "Disc" overlay providing the "Ambush" element of this scheme after the order to discontinue the application of *Zimmerit* paste was received. They also sought clarification from the *Heeres-Waffenamt* as to how to complete Panthers that already had a partial coating of *Zimmerit* paste when it was ordered to be discontinued. They were instructed to complete the vehicles in question with a full coating of *Zimmerit paste*. M.N.H. would continue to complete Panthers in this camouflage scheme until it was superseded by the new striped *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme towards the end of October. Both Panthers were fitted with the new forged armoured exhaust elbows that was introduced to series production Panthers by M.N.H. in late August 1944. (2x Freddy Lemaire LUMA)

131

M.N.H. Panther *Ausführung* G - October 1944



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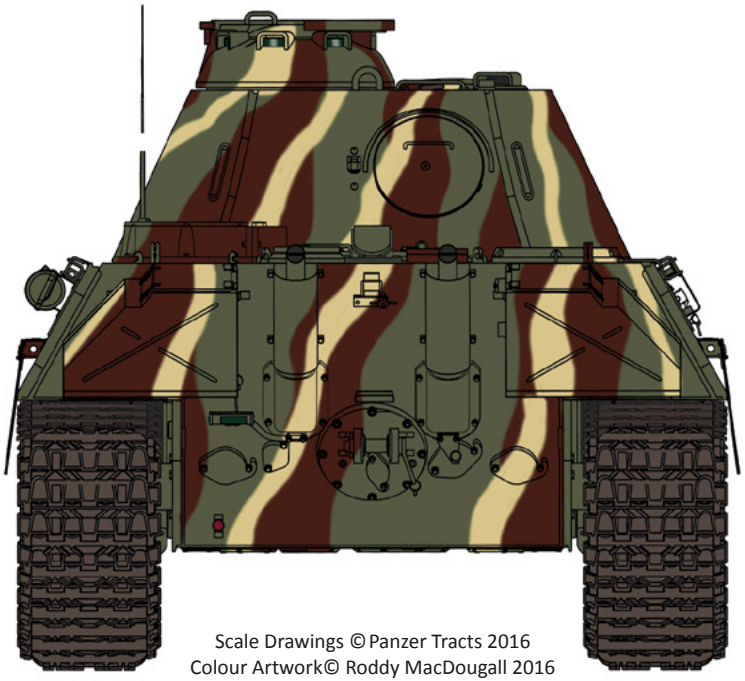

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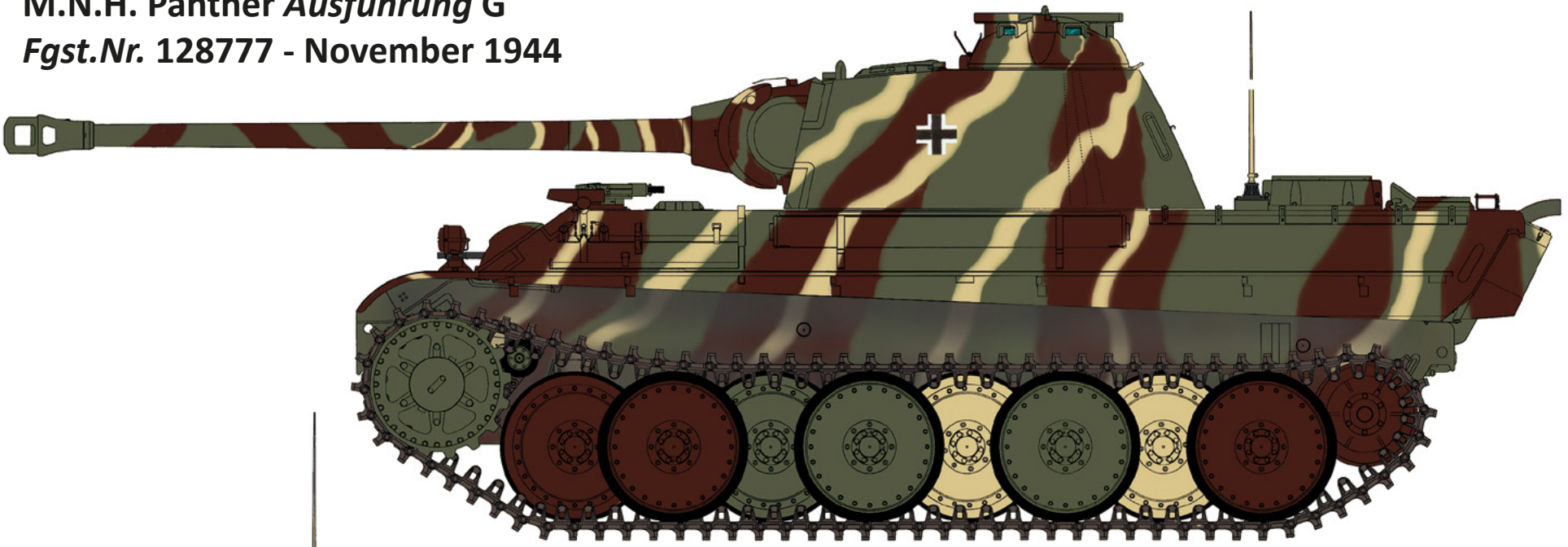
A new camouflage scheme would be introduced towards the end of October that was unique to Panthers assembled by M.N.H. This consisted of stripes or bands of colour crossing the vehicle diagonally from one side to the other including the *Fahrgestell* and *Turm* roof. The basic principles of the pattern would remain the same from this point on to the end of the war. The initial version of this pattern is characterised by four *Dunkelgelb* RAL 7028 diagonal stripes on the glacis plate and depending on where the painters had started, either three or four stripes on the *Turm* side and seven or eight stripes on the *Fahrgestell* sides. The diagonal stripes on the glacis and gun mantle run from the upper port to lower starboard. These *Dunkelgelb* stripes did not usually run parallel with the broader *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 stripes. The pattern would evolve over the coming months with subtle changes being made to the appearance of the stripes. These coincide with modifications to the design implemented by M.N.H. that provide a timeline for the evolution of the camouflage scheme. A careful examination of Panthers with this new camouflage scheme in period photographs has allowed us to determine that the *Olivgrün* RAL 6003 component of this camouflage scheme was applied first. The *Rotbraun* RAL 8017 component was the next colour to be applied. It is not possible to determine from photographs whether the initial coat of *Olivgrün* RAL 6003 was an overall coat but that the Rotbraun RAL 8017 was then applied so that its edges are on top of the *Olivgrün* RAL 6003. It is probable that both colours were applied in alternating bands that covered the vehicle i.e. that there was no complete coat of *Olivgrün* RAL 6003 prior to the application of *Rotbraun* RAL 8017, only those areas that would be visible on the finished vehicle receiving a coat of paint thereby reducing the material necessary to cover the vehicle. The last coloured bands to be applied were the *Dunkelgelb* RAL 7028 stripes; these crossed the vehicle at a slightly different angle to the bands of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 so that these colours were not separated by a *Dunkelgelb* RAL 7028 border. The vehicles 7.5cm Kw.K.42 L/70 main armament was delivered to the assembly plants in either *Dunkelgelb* RAL 7028 or a dark grey coloured heat resistant lacquer. M.N.H. would deliver completed Panthers where the gun had originally been delivered in *Dunkelgelb* RAL 7028 with almost all of this obscured by a heavy application of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017, if the gun was delivered in the dark grey lacquer then a lighter application of *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 was applied leaving some of the dark grey lacquer still visible.

This Panther was issued to II./Pz.Rgt. 33 and was knocked out in the village of Humain, Belgium during the Ardennes Offensive in December 1944. It would be photographed extensively over the following year prior to being scrapped. This has enabled us to determine with certainty the camouflage scheme which is depicted in the colour plates of this Panther on pages 244-245. It was not fitted with *Lost Erkennungstafeln* (poison gas detector panels) on the *Turm* roof and has the tactical number 80 painted on the *Turm* sides, it is also possible to distinguish the striped camouflage scheme applied by M.N.H. on the *Turm*. The *Dunkelgelb* RAL 7028 stripes do not run parallel or form a border between the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 stripes indicating it was completed between the end of October and middle of November 1944. (NARA via Darren Neely)

Panther *Fgst.Nr.* 128777 I./Pz.Rgt. 3 was completed by M.N.H. on or about 7th November 1944 is the subject of the following colour plates. It is one of the Panthers completed by M.N.H. in November 1944 where the *Dunkelgelb* RAL 7028 stripes do not form a border that separates the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 elements of the striped camouflage scheme. This is apparent on the *Turm* side just to the rear of the trunnion armour welded interlock. The 7.5cm Kw.K.42 L/70 main gun has been painted in alternating bands of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 that spiral loosley along its length; a thin line of *Dunkelgelb* RAL 7028 that sprials along half its length has then been painted over this. The debris guard over the gun mantle is missing allowing us to see that there were no L*ost Erkennungstafeln* fitted. This Panther is currently on display at the village Celles not far from where it was originally knocked out. (Jean Petite via Cuivre Plié)

M.N.H. Panther *Ausführung* G
Fgst.Nr. 128777 - November 1944



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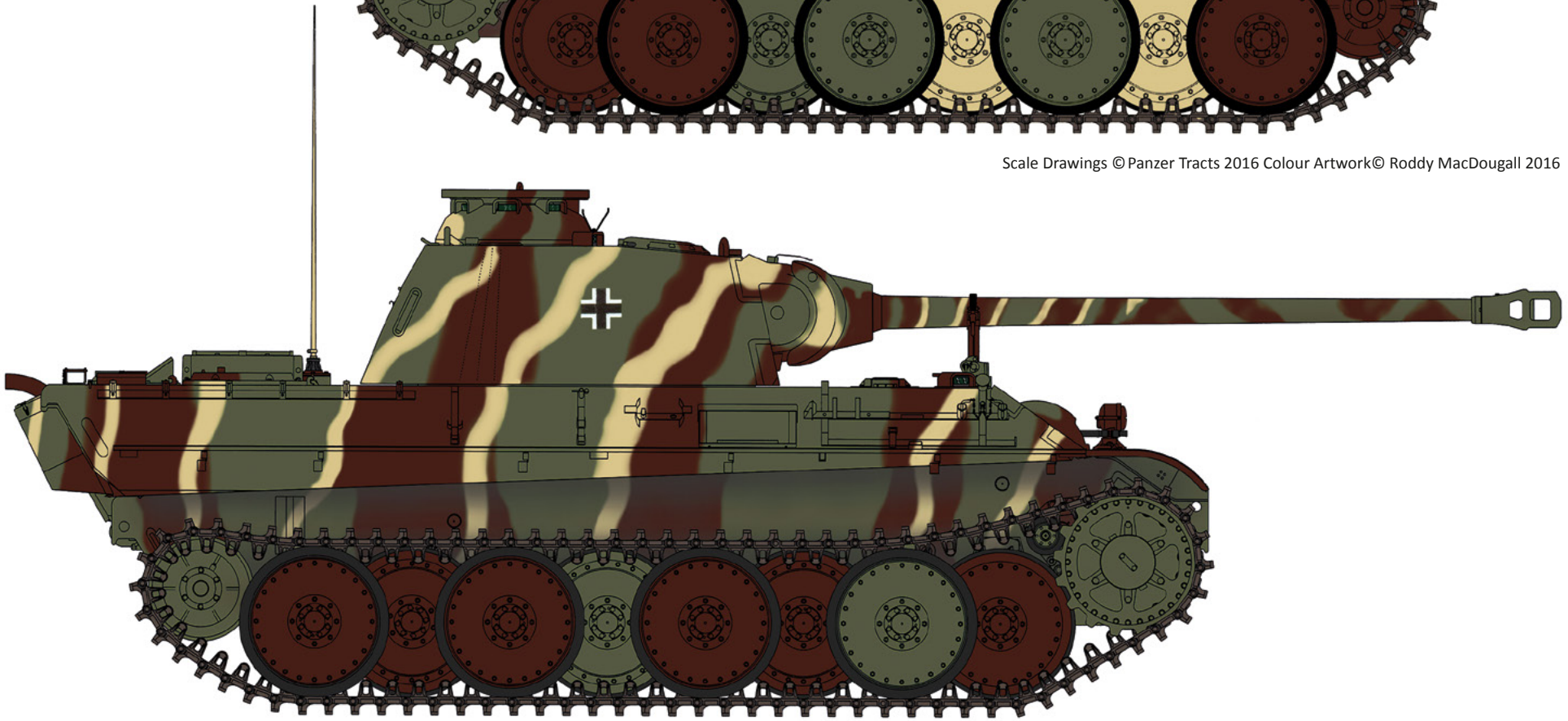

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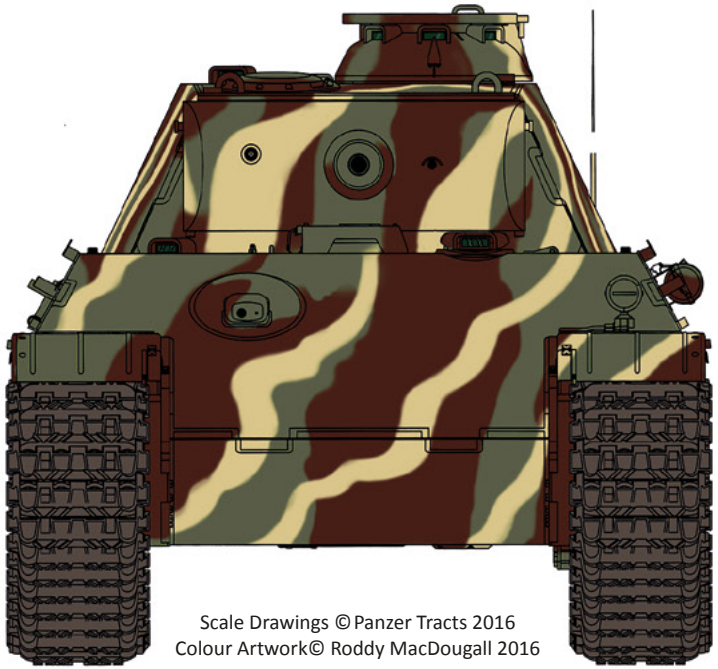

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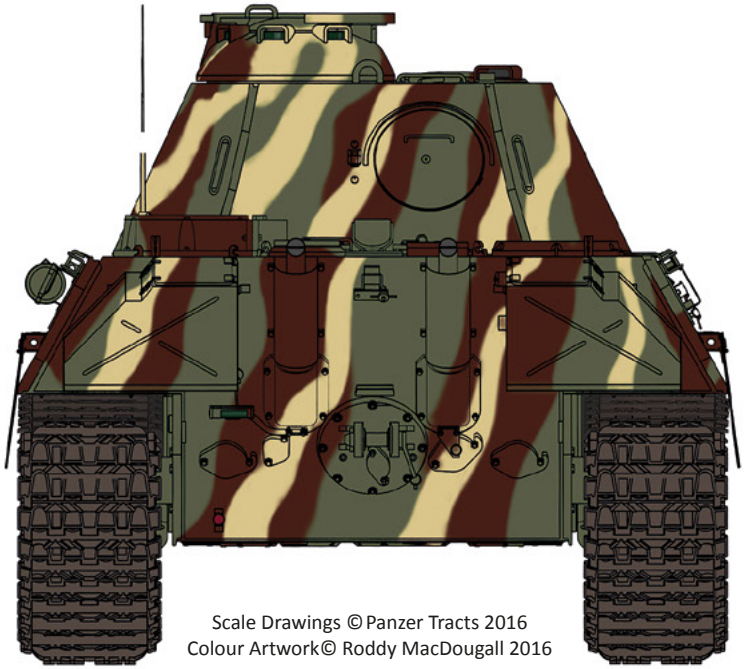

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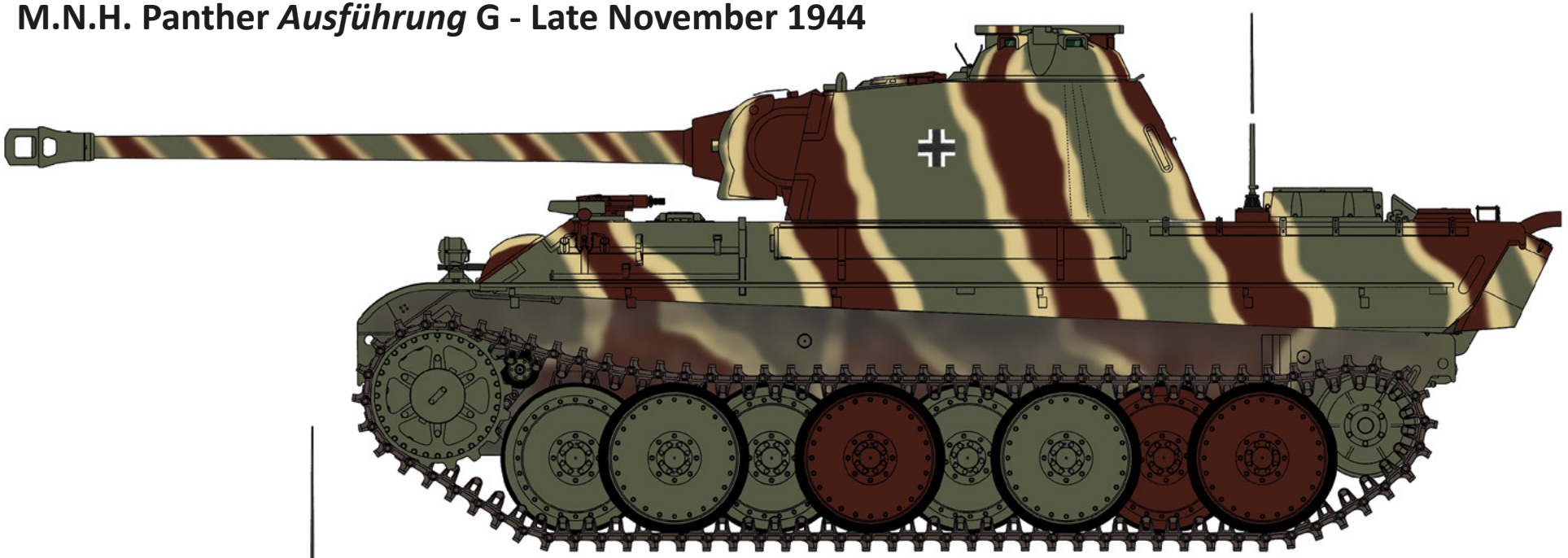
Panther *Fgst.Nr.* 128777 was completed by M.N.H. on or around 7th November 1944 prior to being issued to I./Pz.Rgt. 3. This Panther was knocked out at Celles in Belgium with elements of I./Pz.Rgt. 3 forming part of *Kampfgruppe* Cochenhausen during the Ardennes Offensive. This Panther currently stands next to the road junctions for the N94 and N910 at the entrance to Celles (see page 247). This Panther was extensively photographed after its loss and in varying states of decay over the last seven decades. This has enabled us to determine with accuracy the features and the camouflage scheme present on this vehicle when it was completed by M.N.H. The vehicle was finished in the same *Rotbraun* RAL 8017, *Olivgrün* RAL 6003 and *Dunkelgelb* RAL 7028 camouflage scheme used on the Panther knocked out in the centre of Humain and described in detail on the previous set of colour plates (see pages 244-245). It was fitted with forged armoured exhaust elbows, 600mm diameter *Leiträder* (idler wheels) and a *Warmluftbeheizung* (crew compartment heater). There was a mount for an *Orterkompass* on the *Turm* roof but there were no *Lost Erkennungstafeln* (poison gas detector panels) fitted. The Panther's 7.5cm Kw.K.42 L/70 main armament was delivered to the assembly plants in either *Dunkelgelb* RAL 7028 or a dark grey coloured heat resistant lacquer. M.N.H. would deliver completed Panthers where the gun had originally been delivered in *Dunkelgelb* RAL 7028 with almost all of this obscured by a heavy application of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017, if the gun was delivered in the dark grey lacquer then a lighter application of *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and Rotbraun RAL 8017 was applied often leaving some of the dark grey lacquer still visible. The camouflage applied to the main armament by M.N.H. from late October on typically consisted of stripes that spiralled round the gun barrel or a series of adjacent hoops or stripes along its length. The *Dunkelgelb* RAL 7028 spiral would sometimes run counter to the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 spirals. The camouflage paint applied to the lower *Fahrgestell* sides and sponson floor during its early stages of assembly tend to match the camouflage schemes applied to the rest of the vehicle with considerably more consistency than those of the other assembly firms involved in series production of the Panther *Ausführung* G at this point.

Although it is covered in a thick blanket of snow it is possible to distinguish the striped camouflage scheme applied by M.N.H. to the Panther Ausführung G it assembled. The *Dunkelgelb* RAL 7028 stripes do not run parallel to the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 components of this scheme indicating it was completed between the end of October and middle of November 1944. This Panther was issued to I./SS-Pz.Rgt. 9 and was knocked out some distance northeast of Houffalize, Belgium during the Ardennes Offensive in December 1944. There are no *Lost Erkennungstafeln* (poison gas detector panels) visible on the *Turm* roof of this Panther and it has been fitted with 600mm diameter *Leiträder* (idler wheels). (NARA via Darren Neely)

Panther tactical number 302 from 3./Pz.Rgt. 3 was abandoned outside Hosingen in northern Luxembourg during the Ardennes Offensive. The *Dunkelgelb* RAL 7028 stripes do not run parallel to the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 components of this scheme indicating it was completed between the end of October and middle of November 1944. The strengthened "Chin" gun mantle (021 St 50258) started to appear on a significant number of Panthers completed by M.N.H. from early November 1944 on to the end of the war. This Panther is fitted with the original design of 600mm diameter *Leiträder* (idler wheels) M.N.H. did not start to use the new 665mm *Leiträder* until the very end of November 1944 at the earliest. The gun barrel has patches of *Dunkelgelb* RAL 7028 over what appears to be the grey heat resistant Lacquer over painted with bands of *Olivgrün* RAL 6003 or *Rotbraun* RAL 8017 paint. This Panther would later be used to test the effectiveness of Bazooka rounds on the *Turm* side. (NARA via Darren Neely)

M.N.H. Panther *Ausführung* G - Late November 1944



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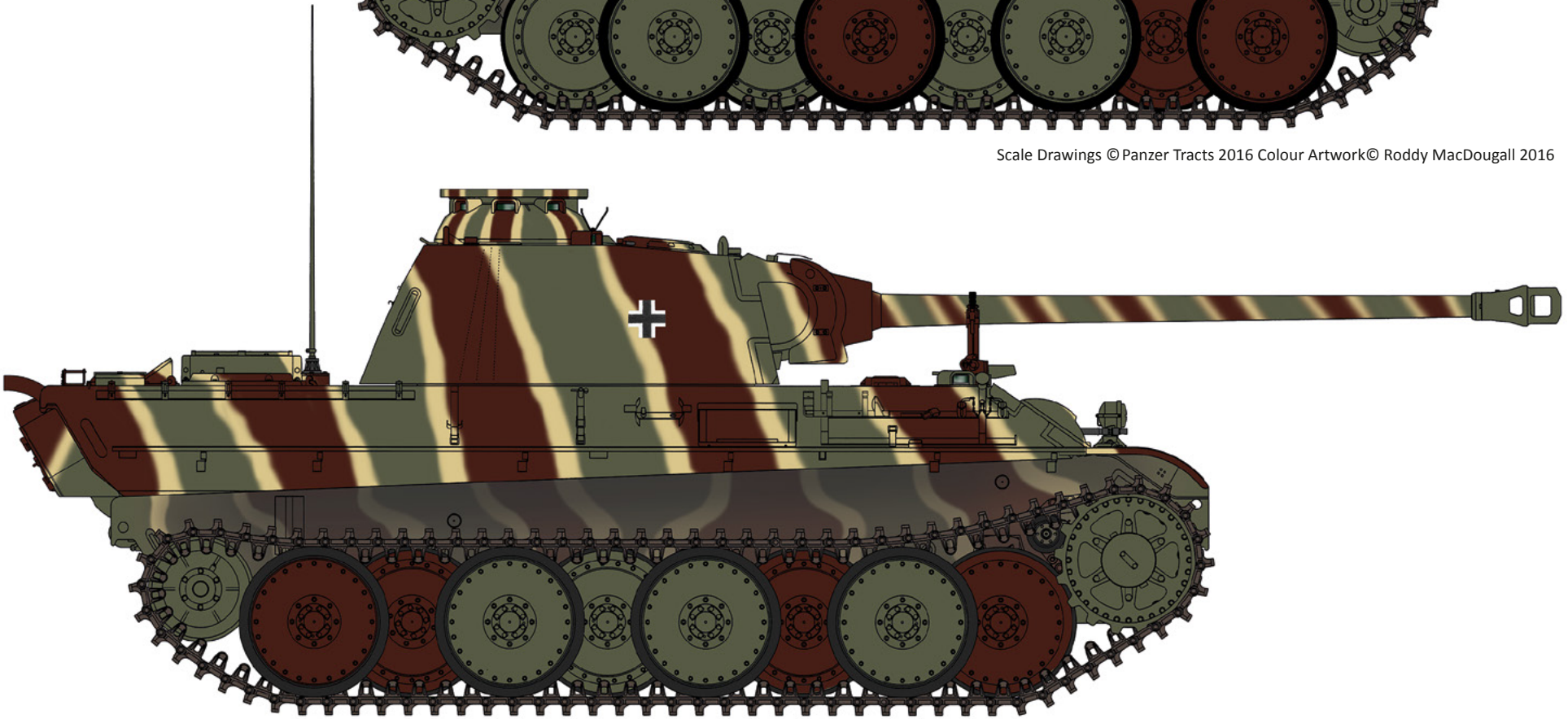

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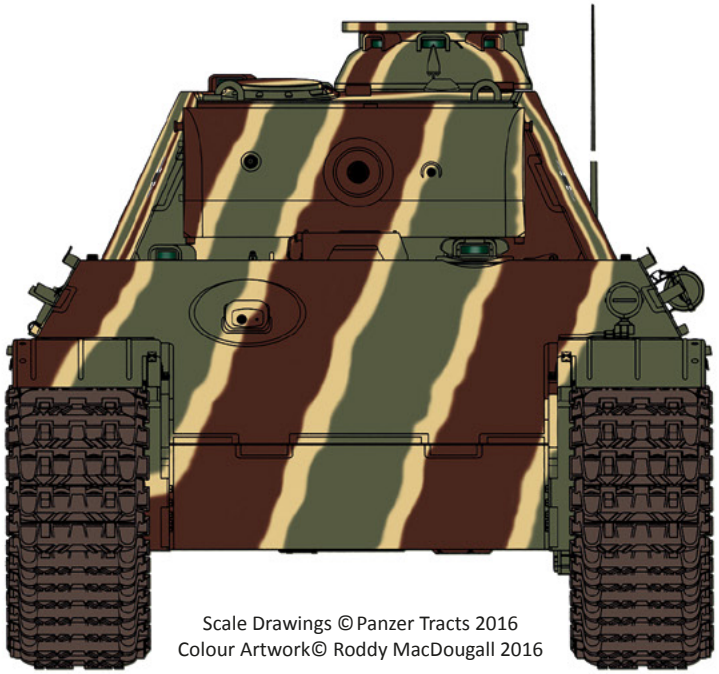

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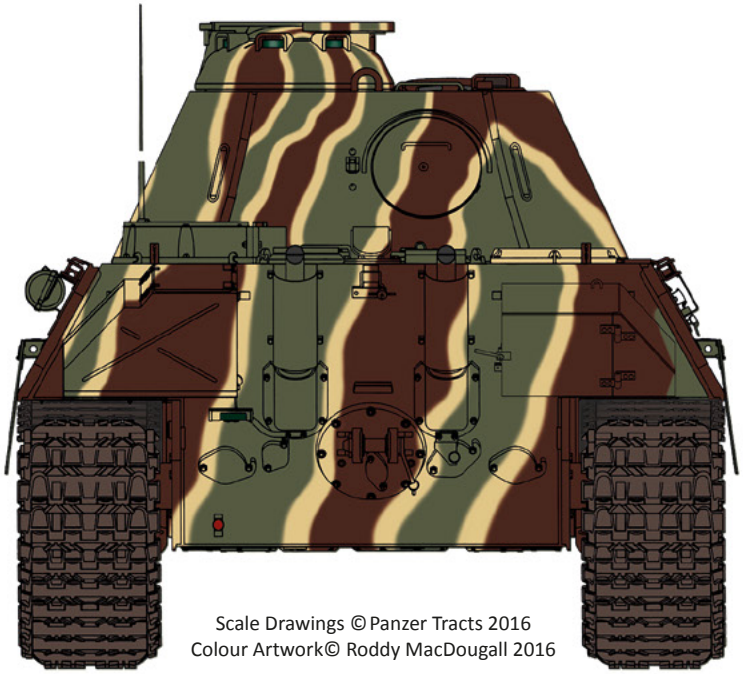

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In mid to late November the striped camouflage scheme applied by M.N.H. would be altered so that the *Rotbraun* RAL 8017 and Olivgrün RAL 6003 diagonal stripes are now separated by *Dunkelgelb* RAL 7028 stripes that borders the *Olivgrün* RAL 6003 and Rotbraun RAL 8017 stripes. The stripes are now more uniform in appearance, as production progresses through to 1945 these stripes become straighter eventually reaching a point in late December where they look as though they have been applied using a straight edge as a guide. This change is characterised by an additional *Dunkelgelb* RAL 7028 stripe on the glacis plate and *Turm* sides. This would increase from either three or four to five stripes. There is a corresponding increase in the number of *Dunkelgelb* RAL 7028 stripes on the *Fahrgestell* sides depending on where the painters started working and the width of the stripes with far more variation in the width and number of stripes applied to the sides of Panthers with this scheme. This could vary from a norm of eight to as many as twelve on one vehicle photographed in 1945. The scheme would also be reversed or mirrored on a percentage of the Panthers completed by M.N.H. from this point on. Prior to this the stripes had always been applied so that they ran diagonally from the upper port to the lower starboard edges of the glacis plate. The relative direction of the stripes on any one would not change when the opposing side was viewed, i.e. when the glacis of any particular vehicle was painted with the stripes running from the upper left diagonally down to lower right, the direction of the stripes on the rear would run the same way when viewed from behind the vehicle. The same is true for the sides of the *Fahrgestell* where the direction of the stripes was the same on the port and starboard sides when viewed from their respective sides. The direction of the stripes on the *Fahrgestell* sides ran in the opposite direction to those on the front and rear of a number of Panthers completed each month from the end of November on. This Panther had some preparation for service with I.R. night vision equipment. The external changes made included the replacement of the starboard *Gepäckkasten* with an armoured stowage box and the mounting points for the 4 pin Bosch lamp socket plate used for an I.R. lamp on the starboard side of the gun mantle. The *Turm* roof has an aperture for the gun control tape that is protected by an armoured horseshoe welded in front of the commander's cupola. The handle on the hatch for the commander's cupola was frequently removed on I.R. prepared Panthers. M.N.H. were still fitting the original 600mm diameter *Leiträder* (idler wheels) and did not install *Lost Erkennungstafeln* (poison gas detector panels) on the Panthers it completed up to the end of November/beginning of December 1944.

This Panther was amongst the first to be completed with 665mm *Leiträder* (idler wheels) by M.N.H. but still does not have *Lost Erkennungstafeln* (poison gas detector panels) fitted on the *Turm* roof. Although the strengthened "Chin" gun mantle (021 St 50258) had been introduced to series production at Hanover in November Panthers would still be completed by all of the assembly plants with the standard "round" gun mantle as is the case here. The striped camouflage scheme applied by M.N.H. was altered in late November so that the *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 diagonal stripes are now completely separated by *Dunkelgelb* RAL 7028 stripes. The glacis plate on this Panther has been marked with a roughly painted black "G" by either its crew or the unit *Werkstatt* to indicate that its motor coolant has been treated with *Glysatin*. (Darren Gawle)

A column of *Ausführung* G Panthers completed by M.N.H. in December 1944 that were subsequently photographed in the vicinity of Küstrin in February 1945. The camouflage scheme consists of *Dunkelgelb* RAL 7028 stripes that separate *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 colour fields with tightly sprayed edges. The colour fields are consistent with no undulations and appear to have applied with a straight edge to ensure uniformity. The second vehicle in the column is one of the small number of vehicles completed each month from November 1944 on with the "Chevron" variation to the camouflage scheme. These Panther all have foliage rings welded on the *Türme* sides as well as rings for the *Fliegerbeschussgerä*t on their cupolas. (Bundesarchiv 183-H28 153)

M.N.H. Panther *Ausführung* G - Late November 1944
Chevron Variation

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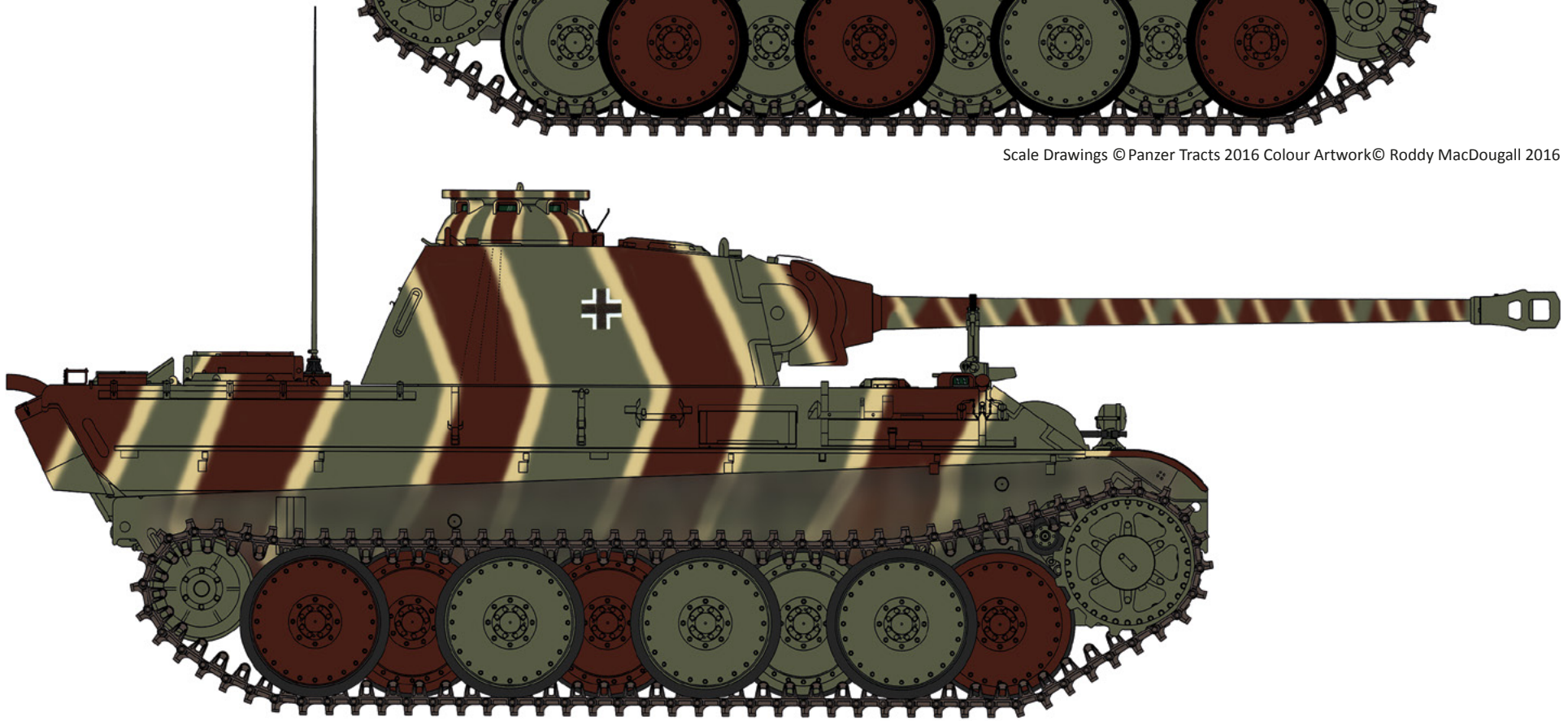

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At the same time that the striped camouflage altered so that the *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 diagonal stripes were separated by parallel *Dunkelgelb* RAL 7028 stripes that bordered the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 stripes, a slight variation to this scheme would appear on a small numbers of Panthers completed by M.N.H. each month up to the end of the war. The linear stripes that made up the pattern on these Panthers were painted as chevrons on the *Turm* and *Fahrgestell* with the apex of these at the *Fahrgestell* roof. An example of this type of "Chevron" camouflage can be seen on a Panther abandoned in Hungary that was completed by M.N.H. in late November or December 1944. We have taken the opportunity to use these plates to illustrate the subtle changes in the appearance of the stripes as November progressed. The frequency and amplitude of the undulations is reduced and the sprayed edges become tighter and neater. The port side is typical of those Panthers completed from mid to late November with the starboard side illustrating the typical stripes applied from the end of November in to December when there would be a further evolution discussed later in chapter 8. All of the assembly plants painted the areas of the lower *Fahgestel*l that would be inaccessible once the running gear was installed in the early stages of the vehicle's assembly.

8. LAST OF THE LEVIATHANS

January 1945

On 3rd January 1945 the *Heeres-Waffenamt* sent detailed instructions to the assembly plants regarding reworking the existing stocks of the old model of tow shackle 021 D 48393-427 that had been replaced by 021 D 51199-22 and the old model bolt 021 E 48393-428 that had been replaced by 021 E 51199-23. The old model bolts could be divided into 2 categories that M.N.H. reported back:

- Finished bolts 021 E 48393-428. There were 426 bolts in stock; these were to be modified according to drawing PV-G595.
- Pre-machined bolts 021 E 48393-428. The premachined bolts needed to be extended by butt welding and finished according to drawing PVG594D, there was no record of how many of these that M.N.H. still had in stock.
- Finished shackles 021 D 48393-427. 1238 pieces of finished shackles should be reworked in the mechanical production, namely the thread should be removed to a diameter of 55mm. Abt.717 was ordered to issue the necessary production papers, as M.N.H. are not allowed to install the older version of the shackles and bolts on the vehicles from 1st January onwards.

On 8th January 1945 the *Heeres-Waffenamt* forwarded an instruction to the assembly firms from *OKH Wa J Rü VIII D (WuG 6)* informing them that only gun sights fitted with lens wipers were to be installed on new Panthers. A set of detailed instructions regarding new components and extensive design changes necessary to accommodate the new FG 1250 I.R. equipment that was currently being redesigned were sent to M.N.H. on 12th January 1945.

On 19th January M.N.H. were again instructed to discontinue all of the internal stencilling apart from "*lose*" and "*fest*" next to the *Turmzurrung* (turret locking mechanism, drawing 021 St 50270), and "*55 kg/cm² braun ark*" on the *Vorholer* (gun recuperator mechanism, drawing 5 St 77009). The *Luftausgleicher* (air balancer mechanism) for the gun and mantle was also to be stencilled with either "*75 bis 80 atü bei 0°*" if the vehicle had the standard "round" gun mantle (021 St 50255) or "*90 bis 95 atü bei 0°*" if the new heavier strengthened " Chin" gun mantle (021 St 50258) was fitted. The stencilling for the radio equipment was to be retained however all other internal stencilling was to be discontinued.

On 12th January the *Heeres-Waffenamt* informed M.N.H. that following discussions the previous day with representatives of Daimler-Benz on the situation regarding FG 1250 night vision equipment. It had been hoped to start preliminary assembly from 15th January onwards. An extensive set of instructions and a parts list of components that had already been supplied that were either to be included in the preliminary preparations or omitted was attached. Some of these components were no longer valid for the FG 1250 equipment that was then undergoing a redesign. M.N.H. would need to obtain or produce some of the components themselves later on. Until then, they were told that they would receive 180 sets from the *Heeres-Waffenamt*. The remaining parts, for example the armoured boxes would be held back temporarily and they would be advised on the delivery of these parts by the *Heeres-Waffenamt*.

Specific details that needed particular care during installation of the FG 1250 equipment were highlighted such as the segment 27.8801.004-5002 (3) that was to be installed on the gun. The current *Folgezeigeranlage* (pointer tracking system) was to be reduced to the parts indicated on the attached page. Both of these components were only to be welded in place using a template to ensure they were aligned correctly.

There was to be no wiring for this device installed in the *Turm*, the complete electrical cabling in the *Turm* for the FG 1250 was to be omitted. The only remaining electrical cable in the *Wanne* is the one from the slip ring assembly to the main switch or fuse. After the 10 contact studs slip ring assembly has been exhausted, it was to be replaced with the 11 contact studs version in order to create uniformity with the command tanks. The cable to the fuse box on the starboard side is to be dropped. The frame for the GG400 generator and the battery were to be removed. The opening for the frame of the GG400 was to be closed with cover 27-8801.008-66 (3) from subgroup 008-5015, of which the cap 27-8801.008- 67 with -71 and -72 is to be removed. The hole in the separation wall for the exhaust pipe of the GG400 is to be closed with dummy cover PV-G 599 and the original seal. Frame 27-8801.008-5001 (2) should not be installed, only bracket -80 (5) should be welded according to the template with the lower front bracket remaining in place due to the different design of the frame. In the commander's cupola, segment 27-8801.001-5001 (2) was to be welded on the *12-Uhr Zeigerring* (azimuth indicator ring) until the delivery of a new reinforced azimuth indicator ring by the sub contractor Hupmann. The *Abnahmestelle* Inspection team would report the introduction of these new cupolas, because the vehicles with the new azimuth indicator rings needed to be reported to the *Heeres-Waffenamt* as they were to be equipped with a new receiver. The angled mount for the FG 1250 searchlight needed to be altered according to drawing 27-8801.008 (2) Page 1 Design Change 'F'. Finally, the calibrating process for the FG 1250 was not to be done, the gun and optics were to be calibrated as normal. Abt.774 should report the introduction of the commander's cupola with the reinforced azimuth indicator ring to the *Heeres-Waffenamt.*

This extensive set of instructions is important as it illustrates that although a sizeable number of vehicles had been scheduled to be prepared for use with FG 1250 night vision equipment since July, none of them were combat ready for use with this equipment when they left the assembly plants for service with the troops. The design of the FG 1250 was still being worked on and several important components had still not been delivered amongst them the mount for the unit as well as drives for equipment installed in the commander's cupola[1].

On 16th January the *Heeres-Waffenamt* wrote to the assembly plants regarding the *Kraftstoff siebfilter* (fuel sieving filter) SB 136 per drawing 021 E 48328-214. Due to the expansion of the delivery programme, it was necessary to introduce a new type designation to avoid confusion with the modified version. The new type designation was to be SB 136/18, indicating that the connecting thread in the housing is M18x1.5mm. The same filter was also supplied with an M14x1.5mm connection thread but is used for different purposes. This version received the type designation SB 136/14. Because both filters have the same external appearance, it will be necessary to use the type designations during any correspondence to avoid potential confusion. The assembly plants were informed on 19th January by the *OKH* that all motors for armoured vehicles were to be filled with winter oil. Abt.4111 had advised that winter oil would be available to the plants from 1st February 1945 onwards. From that moment onwards all armoured vehicles were to be filled with winter oil.

The *Heeres-Waffenamt* sent instructions to reduce the number of bolts on the engine deck on 20th January. In accordance with M·A·N design change proposal 273, half of the fixing holes in the motor cover plate 51152 -8 for the engine were to be dropped. The reason for this was the loss of bolt production capacity and problems experienced with obtaining supplies of these bolts. The *Heeres-Waffenamt* had allowed the assembly plants to plug half of the holes so only half the number of the bolts was now needed. The holes were to be plugged as per drawing PV-G 603 E. Pre-assembly was requested to drill only half of the holes in the *Wanne* and to plug the remaining holes in the motor cover plate 51152 -8. 18 closure plugs were needed per vehicle. Abt.717 was to issue the production papers required immediately. M.N.H. was asked to report the *Fahrgestell* numbers with this design change to Abt.703 or 733.

M.N.H. reported on 23rd January that they had received supplies of *Absatzkrümmer* hoods for the *Flammenvernichter*, they later reported that *Fgst.Nr.* 128997 to *Fgst. Nr.* 129016 completed between 25th January and 1st February had been fitted with *Absatzkrümmer*. Daimler-Benz would not commence installing *Absatzkrümmer* until the end of January 1945 at the earliest[2]; M·A·N did not fit *Absatzkrümmer* hoods to any of the Panthers they completed.

M.N.H. was instructed to immediately cease welding the ring on to the commander's cupola for the *Fliegerbeschussgerät* on 24th January 1945 as a new post mount for the anti aircraft machine gun was to be introduced. Daimler-Benz would continue to weld the ring for the *Fliegerbeschussgerät* to the commander's cupola on all of the *Ausführung* G Panthers they completed. Given the volume and detail of the communications between the assembly plants and the *Heeres-Waffenamt* relating to the redesigned FG 1250 I.R night vision equipment and particularly its new mount it is probable that the need to accommodate this led to the decision to remove the ring for the *Fliegerbeschussgerät* rather than any significant savings in material or labour.

A separate set of instructions regarding components that were being removed to reduce materials and labour was sent on 24th January. The assembly plants were no longer to install the connecting link for 18° internal travel lock or the loader's seat. The latter component was only installed in Pz.Bef.Wg. Panthers. According to a supply instruction all weapons and optics in the turret of closed vehicles were to be devoid of all coatings. For the Panther and Jagdpanther following coatings are to be discontinued: *Verschluß* (gun breech), *Turmzielfernrohre* (gun sights) and *Wischer* (wiper system).

Around the same time the assembly plants were instructed to reduce the number of bolts used to install the engine deck from 36 to 18 and plug the remaining apertures. This modification is extremely difficult to see in period photographs. As we have seen, design modifications or new components were often introduced or trialled by the assembly plants before official instruction were received to introduce these modifications to series production. Panther *Fgst.Nr.* 128998[3] was the 2nd Panther fitted with *Absatzkrümmer* on its *Flammenvernichter* completed by M.N.H. on 25th January 1945. It also had welded exhaust armoured guards, five rings for attaching foliage to the *Turm* sides and appears not to have had ring for the *Fliegerbeschussgerät* welded on the commander's cupola. The vehicles crew or unit *Werkstatt* removed the foliage rings in order to mount spare tracks as additional armour, a common practice adopted by units after the experience gained in Hungary. The witness marks from the foliage rings are clearly visible so there is no doubt that these were originally present when the vehicle was issued to the troops. The periscope guard that would have the new post mount for the *Fliegerbeschussgerät* has been blown off so it is impossible to confirm whether this was present when the vehicle was completed, however the remaining periscopes do not appear to have any mounting tabs on them indicating that a ring mount may not have been fitted. We are sure about the date of production and *Fgst.Nr.* of this vehicle as it was stencilled on the glacis plate in black underneath the *Kugelblende*. This is the only post July 1944 Panther assembled by M.N.H. where this number is clearly visible in a period photograph. M·A·N start to fit the new post mount on the commander's cupola for the *Fliegerbeschussgerät.* These were welded to the steel plates used for the original *Fliegerbeschussgerät* ring towards the end of

1 The "drives" referred to relate to the target aquisition system for the FG 1250.

2 Daimler-Benz had still not installed *Absatzkrümmer* hoods on the Panthers for I./Pz.Rgt. 2, 16.Pz.Div that were picked up on 20th February 1945. See Urbanke: *Endkampf*.

3 Panther *Fgst.Nr.* 128998 knocked out and photographed at Klenovice in Czechoslovakia and has the name "Siggi" painted in white diagonally across the glacis. See: *AFV Photo Album Volume 2* and page 263.

January[4]. It makes no sense to remove the original *Fliegerbeschussgerät* ring as an economy or labour saving measure in order to fit a post mount, the only reason there might be for doing so is if there is a technical purpose for doing so. It is likely that the technical reason was the new cupola mounts for the FG 1250 equipment which were undergoing a redesign at the time.

Combat experience gained in Hungary saw the widespread introduction of spare tracks hung on the *Turm* sides as additional armour by units fighting on the Eastern Front who had not previously adopted this practice. It should be noted that a number of Germany's former allies were reequipped by Soviet forces with captured Panthers which were now used against their former owners. This led to some units instructing their *Werkstatt* personnel to apply additional *Balkenkreuze* to their Panthers in an effort to reduce the potential for friendly fire incidents. These additional *Balkenkreuze* can invariably be seen on vehicles issued to units serving on the Eastern Front in 1945 and fitted with spare tracks on the *Turm*.

In late January or February Daimler-Benz or possibly Alkett (Altmärkische Kettenfabrik GmbH) completed a small number of Panthers where one or both of the *Balkenkreuze* national markings have been painted on the *Turm* sides, just underneath the spare track stowage on the hull or a combination of these. A number of these Panthers also have the rear *Balkenkreuz* painted underneath the jack stowage bracket rather than on the port side *Gepäckkasten*. These vehicles all have the road wheel stowage brackets previously associated exclusively with Daimler-Benz assembled Panthers fitted to their *Türme*. Some of these vehicles were issued to I./Pz.Rgt. 9 on 3rd March 1945 and were subsequently photographed at the vehicle collection point in Znojmo in Czechoslovakia after the war.

The R.A.F. carried out a particularly heavy air raid dropping 2156tons of ordnance on the night of 2nd/3rd January 1945, this effectively wiped out any significant Panther production at the M·A·N facility for the rest of the war. A teleprint giving details of the damage to the plant was sent to the armaments ministry on 4th January by Mr. Mader, the *Leiter des Arbeitsausschusses Panther Fertigung* (leader of the commission for Panther production) or Buro Mader as it was referred to in communications with the assembly firms. It stated that the plant had no electrical power, gas or water and that significant damage had been inflicted on buildings used for production of the Panther. Mr. Mader also stated that only 10% of the employees were able to report for work due to the lack of transport caused by the considerable damage to the infrastructure in the surrounding area. One of the most significant pieces of correspondence relating to Panther production at the M·A·N Nürnberg facility in 1945 was sent by Mr. Lucht to a Mr. Claaszen at the *Reichsministerium für Bewaffnung und Munition* in Berlin on 22nd February 1945 following two further heavy raids by the U.S.A.A.F. on the 20th and 21st of February. This correspondence lists the material and manpower needed to effect repairs at the M·A·N plant in Nürnberg and restore the plant's Panther production capacity. The most significant part of the report is an addendum for the *Staatssekretär* of the *Reichsministerium für Rüstung und Kriegsproduktion* (State secretary of the Reich Ministry for Armaments and War Production), Karl-Otto Saur, giving details on the number of Panthers completed and under construction compared to the projected 50 vehicles that the armaments ministry wanted M·A·N to complete in February. The figures given for the month up to 22nd February were 16 Panthers completed and accepted by the *Wehrmacht* then delivered. An additional three Panthers were accepted by the *Wehrmacht* but had not yet been delivered giving a total of nineteen Panthers completed for February. There were a further seven Panthers that were still being worked on that could be completed if electricity, gas and water were restored at the plant before the end of the month. Significantly, the correspondence goes on to say that twenty *Wannen* were also completed at Alkett by M·A·N personnel that were not included in the projected figure of twenty six for February. It is possible that the Panthers with the *Balkenkreuze* on the *Turm* sides and spare wheel brackets are the twenty Panthers assembled at Alkett referred to in Mr. Lucht's correspondence for *Staatssekretär* Saur.

February 1945

M·A·N are still painting completed Panthers in the camouflage scheme introduced in November 1944.

M·A·N and M.N.H. start to weld sheet metal spring clips to the inner face of the driver and radio operator's hatches, these are intended to hold the tubular levers that would assist the crew member in closing these hatches[5].

There is some evidence to suggest that modifications that would be incorporated into the forthcoming *Ausf.* F to enable any vehicle to be easily converted to a Pz.Bef. Wg. Panther were trialled by M·A·N around this time. Panthers that do not have the coaxial MG plugged, but are equipped with a 2.0m antenna or the *Antennenfuss* on the *Turm* roof to allow the FuG 5 radio to be fitted in the *Turm* were photographed in East Prussia and Czechoslovakia[6]. M.N.H. completes a small number of *Ausf*. G *Fahrgestell* that have the new design of *Kugelblende* intended for use with the *Sturmgewehr* 44 on the Panther *Ausf*. F. This component was welded to the *Wanne* by the armour manufacturers.

4 This post can be seen on Panther *Fgst.Nr.* 121384 completed by M·A·N in the last week of January 1945 and issued to I./Pz.Rgt. 10 which was abandoned in Jevicko, Czechoslovakia. This Panther also has a set *gummisparende Laufrollen* on its eighth road wheel station as well as the three colour camouflage scheme introduced in November 1944.

5 Panther *Fgst.Nr.* 129113 completed under R.E.M.E. supervision using original parts at M.N.H.

6 The *Fgst.Nr.* is illegible I./Pz.Rgt. HG, See: Urbanke: *Endkampf* and the Panther at Teplice in *AFV Photo Album Volume 2* and page 263.

March and April 1945

The final instruction regarding the FG 1250 for which there is a surviving record was sent to M.N.H. on 2nd March 1945 by *Staatssekretär* Saur through Buro Mader in Berlin. He informed M.N.H. that the *Heeres-Waffenamt* (Inspector Weidauer *WuG 6*) would temporarily tolerate the delivery of 20 old model commander's cupolas without a *Seitenzurrung* (clamping system) as per drawing 8001-001 505 for the FG 1250. A post war Allied intelligence report that draws on original German documents as well as interrogations of key figures in the design and development of I.R. equipment notes that the redesigned FG 1250 and its mounting for use in the Panther were not expected to be ready until mid 1945.

Following the R.A.F. air raid in January, M·A·N appear to have moved the final assembly of their Panthers to Grafenwöhr. In his correspondence to Mr. Mader, the *Leiter des Arbeitsausschusses Panther Fertigung* (leader of the commission for Panther production) on 22nd February, Mr. Lucht requested the ministry's approval for alternative arrangements to move the completion of Panthers to a new site. This proposal had been discussed during a meeting between M·A·N management and the *Wehrmacht* inspectors who proposed moving the completion of M·A·N Panthers to the facilities at Hainberg instead of Grafenwöhr as previously agreed. Mr. Lucht then went on to say that there would be a saving on time and fuel if this alternative arrangement was accepted and that the improved weather in spring and summer months would reduce some of the problems associated with this site[7]. There are other indications that final assembly was moved to Grafenwöhr, Panzer crews from I./Pz.Rgt. 3 picked up the last 12 Panthers assembled by M·A·N from Grafenwöhr on 3rd April 1945. It would seem that the alternative proposal to use the site at Hainberg to complete the final assembly of M·A·N Panthers was not accepted and that the original arrangement to use Grafenwöhr's facilities, as indicated in Mr. Lucht's correspondence, was retained. This is reinforced by the fact that not all of these vehicles were fully complete with a number missing the gun cleaning tools tube and at least one had the *Gepäckkasten* frame fitted but not the sheet metal box itself. This method of construction can be seen on partially completed Panthers undergoing the test drives that formed part of the *Abnahmestelle* inspections at Hainberg. There was also a distinct lack of any partially complete Panther *Türme* or *Wannen* undergoing assembly or stock of these armour components at the M·A·N plant in Nürnberg when this was overrun by U.S. forces in mid April 1945.

A small number of Panthers completed by M·A·N at Grafenwöhr are finished in a new camouflage pattern that consisted largely of *Dunkelgrün* RAL 6003 and *Rotbraun* RAL 8017 with an inconsistent percentage of *Dunkelgelb* RAL 7028 between vehicles. This new camouflage pattern had sharp or very tightly sprayed edges to the colour fields. The last circa 15 to 20 Panthers completed by M·A·N at Grafenwöhr had a camouflage scheme consisting of *Dunkelgrün* RAL 6003 with *Rotbraun* RAL 8017 that has a true sharp edge to the colour fields. There is considerably greater variation in the patterns used on these last Panthers than those previously assembled by M·A·N. It is likely that the finish was applied according to a set of written guidlines rather than from a template sent out from the *Heeres-Abnahmestelle* as there is very little similarity to the shape of the colour fields. As previously mentioned, the gun cleaning tools tube was not fitted to some of these M·A·N Panthers and at least one has the frames for the *Gepäckkasten* fitted but not the boxes themselves. The majority of thse Panthers had *Balkenkeuze* on the *Fahrgestell* and the white flat topped "A" indicating they had been accepted by the *Heeres-Abhamestelle* inspectors for service with the *Wehrmnacht*. Most of these vehicles had no *Fahrgestell* number stencilled on the glacis plate and a very small number, single digits, had no *Balkenkreuze* applied or *flat topped "A" marking* before being taken over by the troops indicating these had not been fully completed before being pressed into service. The majority of these last vehicles were issued to I./Pz.Rgt. 3 at Grafenwöhr and were lost in combat operations around Steinach an der Saale between 6th and 8th April. The survivors retreated to Traunstein before going on to Salzburg in Austria where the last Panthers were surrenderd by their crews or destroyed to stop them falling into Allied hands. Other units that possibly also received some of the last Panthers assembled by M·A·N in April are 4./ Pz.Rgt. 11, II./Pz.Rgt. 22 and II./Pz.Rgt. HG.

A small number of the last *Ausführung* G Panthers completed by Daimler-Benz were issued to the troops fighting in the final battle for Berlin without any *Balkenkreuze* national markings. Several photographs of two Daimler-Benz assembled *Ausf*. G Panthers issued to I./Pz.Rgt. 29 and abandoned in Berlin at the end of the war show that they also appear to have adopted or trialled a camouflage scheme with remarkable similarities to the schemes used on the last Panthers completed by M·A·N. These Panthers have small 600mm diameter *Leiträder* (idler wheels), partial I.R. preparation, *Flammenvernichter* with *Absatzkrümmer* and the mounting brackets for spare road wheels on the *Turm* sides that were unique to Daimler-Benz. Daimler-Benz would commence assembly of Panther *Ausf*. F *Wannen*, none of which were completed before the assembly plant in Marienfelde was overrun by Soviet forces in late April.

7 A copy of this correspondence is on file at the NARA.

1945 deliveries and shortfalls

A statistical analysis of deliveries in 1945 compared to completed vehicles reveals some interesting information.

Month	Completed	Issued	Variation	Cumulative Shortfall
January 1945	209	248	-39	-198
February 1945	128	180	-52	-159
March 1945	66	129	-63	-107
April 1945	49	93	-44	
Totals	452	650	-198	-198

If we consider that there was no tank park of completed but unissued Panthers at the end of the war as almost every single Panther that was combat ready had been issued to the troops and then work backwards, we can see that there was a continuous shortfall of vehicles completed by the assembly plants in a given month against those issued to the troops from Autumn 1944 on. This becomes particularly acute when looking at the number of Panthers issued in 1945 against those completed with 93 Panthers issued in April 1945 compared to the 49 completed by the assembly plants before these were overrun by the Allies. This leaves a shortfall of 44 vehicles issued in April that could only have come from vehicles completed in previous months. If we take this shortfall into account and then look at the 66 Panthers completed in March 1945 only 22 of these Panthers could have been issued to units in March 1945 as the remaining 44 vehicles were issued in April.

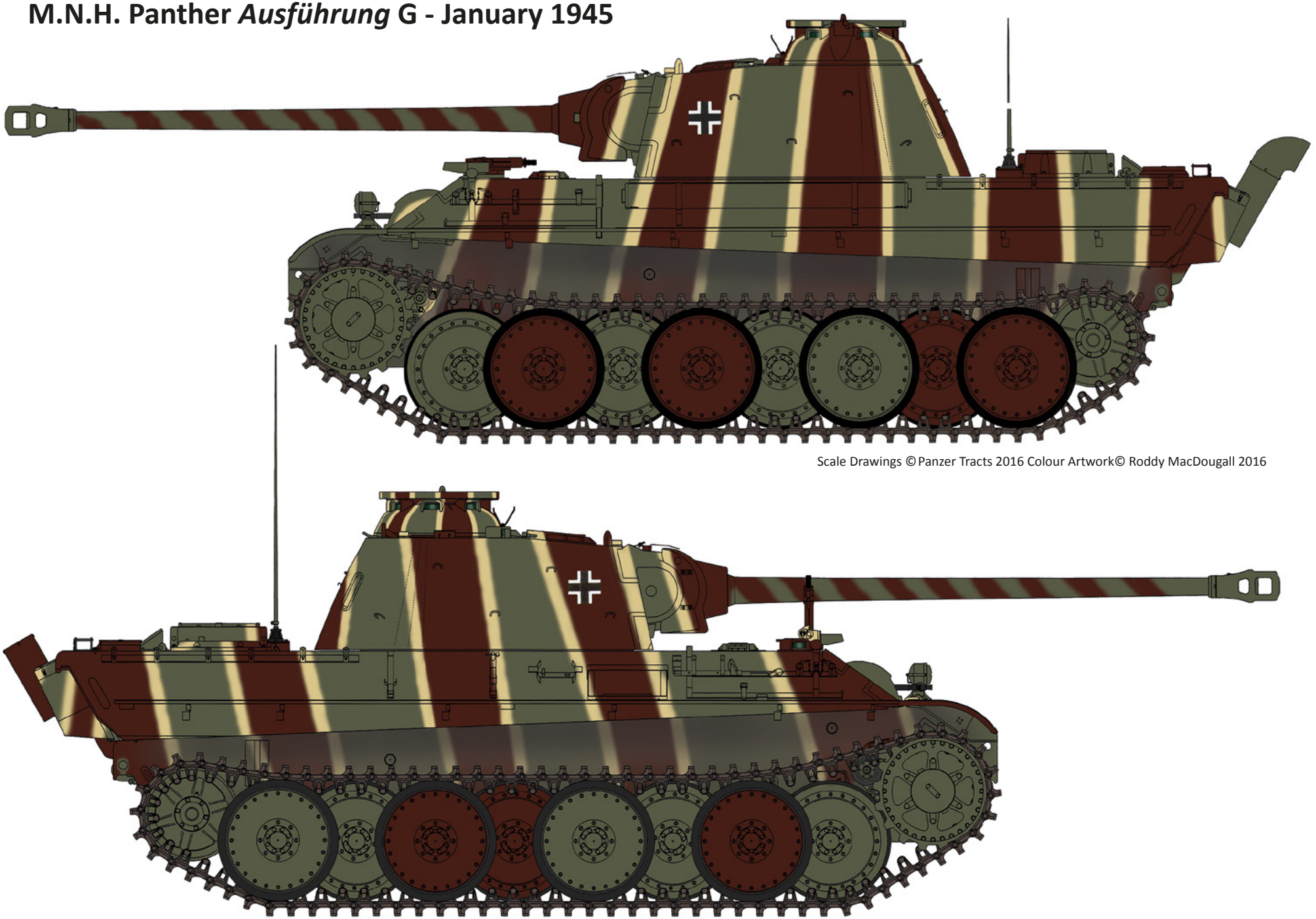
If we extrapolate these figures back and include the cumulative shortfall as a result of production versus deliveries from April into March 1945 figures we can see that 129 Panthers were delivered but the number of Panthers completed was only 66 leaving a shortfall of 63 vehicles. This figure is not strictly speaking accurate because from the 66 vehicles completed in March we also need to allow for 44 that were issued in April. If we add the shortfall from April to March, we can see that we have 107 Panthers issued in March that must have been completed prior to this date. The shortfall in vehicles completed compared to those issued becomes even worse in February 1945 with 180 Panthers issued to the troops but only 128 completed, of which 107 were issued in March 1945.

If February is viewed in isolation there is a shortfall of 52 Panthers completed against those issued, however we must add the cumulative shortfall of 107 vehicles from March and April to this giving us a figure of 159 Panthers that must have been completed prior to February 1945. This trend continues back into January 1945, with 209 Panthers completed compared to 248 issued leaving a shortfall of 39 Panthers that had to be completed prior January 1945, however we have also to include the 158 Panthers that have accrued from February, March and April to this to reach a total of 198 Panthers from the 650 that were issued in 1945 that must have been completed before 31st December 1944. To add to this confusion there might need to be an allowance made for the unknown number of Panthers that Alkett may have completed. There was almost always a delay between the completion of a vehicle and its issue to the troops throughout the production history of the Panther. In a relatively small number of cases there are instances of small groups of vehicles being issued to the troops within days of completion. These are often post June 1944 and just prior to, or immediately after a unit has been rushed to the front. A high percentage of these Panthers were lost within days of being issued. This has led to some interesting anomalies with vehicles often being described as a “late production 1945 Panthers” that were in fact built in 1944 or Panthers that were weeks apart on the assembly lines being issued almost simultaneously. The most important assembly firm involved in the design and production of the Panther was M·A·N. The damage caused to its facilities in Nürnberg following the extremely heavy RAF air raid on its facilities on the night of 2nd/3rd January 1945 would have a significant effect on the overall number of vehicles completed as well as the introduction of any further technical developments to the series.

The *Heereszeugämter* were responsible for issuing new Panthers to the troops primarily through their facilities at Altengrabow, Sennelager and Grafenwöhr. The allocation of Panthers to individual units was made by the offices of the *Generalinspektür der Panzertruppen* who were responsible for the organisation, training and replacement of all Panzer troops including the *Waffen-SS* and *Luftwaffe*. This organisation was tasked with ensuring the efficient distribution of all Panzers to the troops. New Panthers were issued to units based on the available supply, vehicles from any of the assembly plants could be issued to any one unit so that it was possible for all of the vehicles from a particular delivery to have come from one assembly plant or all three. An examination of the groups of vehicles typically issued from June 1944 on in a single delivery show that these are usually, but not always, from one or two assembly plants depending on how many vehicles were involved.

Panther *Fgst.Nr.* 128998 completed by M.N.H. on 25th January 1945 was the 2nd Panther fitted with *Absatzkrümmer* hoods on its *Flammenvernichter*. It also had welded exhaust armoured elbows, five rings for attaching foliage to the *Turm* sides and may not have had ring for the *Fliegerbeschussgerät* welded on the commander's cupola. The vehicle's crew or unit *Werkstatt* removed the foliage rings in order to mount spare tracks as additional armour. The *Fahrgestell* number has been stencilled underneath the *Kugelblende*, this is the only known instance of this on a Panther *Ausführung* G completed by M.N.H. The periscope guard that would have the new post mount for the *Fliegerbeschussgerät* has been blown off so it is impossible to confirm whether this was present when the vehicle was completed, however the remaining periscopes do not have appear to have any mounting tabs on them indicating that a ring mount was never fitted. This Panther was issued to I./Pz.Rgt. 27 and had the name "Siggi" painted on the glacis plate when it was knocked out in Klenovice in Czechoslovakia. (Petr Dolezal and Marek Solar)

M.N.H. Panther *Ausführung* G - January 1945



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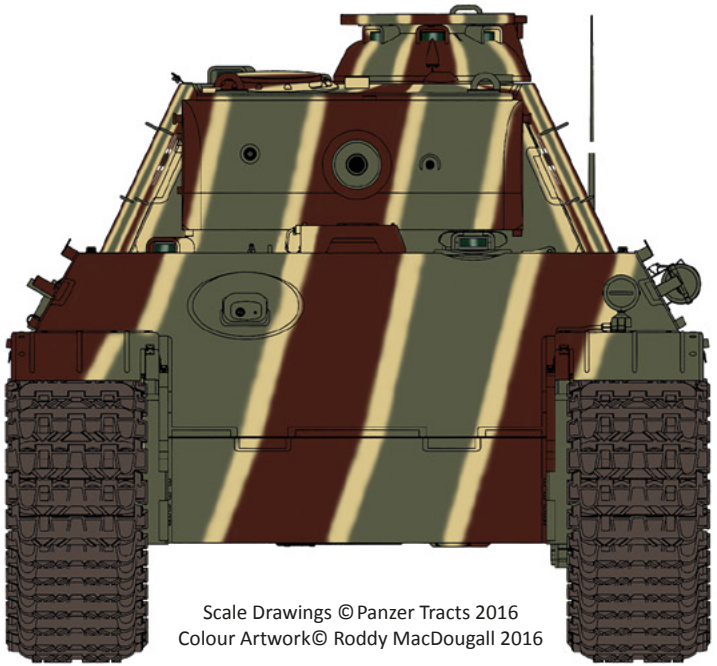

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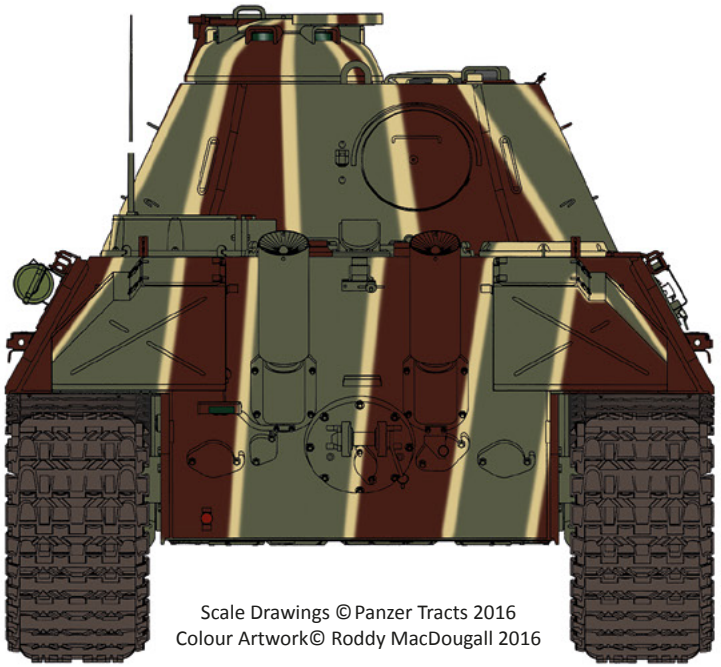

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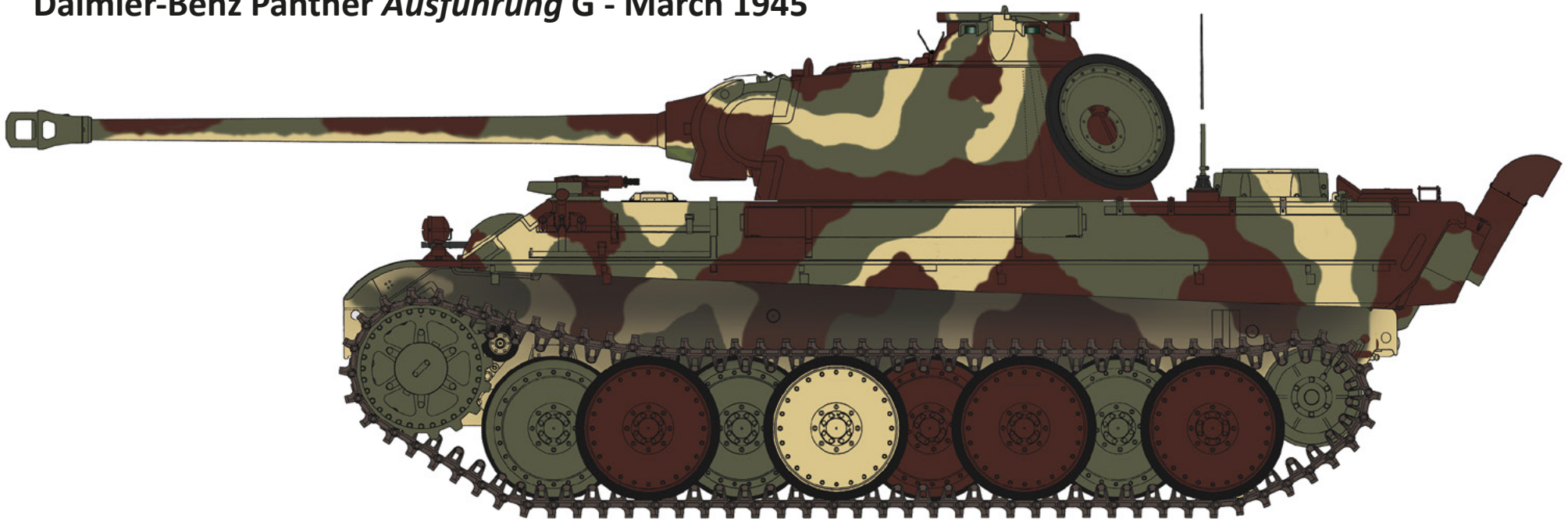
As December progressed the edges to the *Rotbraun* RAL 8017 and *Olivgrün* RAL 6003 diagonal stripes are now separated by Dunkelgelb RAL 7028 stripe that borders the *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 stripes that formed the camouflage scheme applied to M.N.H. Panthers had a much tighter sprayed edge that viewed from any more than a few meters' distance appears to have a hard, sharp edge as though applied over a mask or with a roller or brush. This is on a par with the tightly sprayed edges achieved by Daimler-Benz, neither of these assembly firms would complete Panthers with camouflage applied with a true hard or sharp edge. The stripes are also considerably more linear in appearance and on the majority of vehicles assembled from the end of December on typically appear to converge on the *Turm* roof. The factory applied camouflage scheme applied at M.N.H. would now retain these features until the plant was overrun by Allied forces at the end of the war. There would be very few external modifications to the vehicle from this point on. The ring for the *Fliegerbeschussgerät* anti aircraft mount would be replaced by a simplified post design on completed vehicles from the end of January 1945. A new central engine cover that had fuel and water filler ports that are the same dimensions was fitted to a high proportion of Panthers completed by M.N.H. from the middle of January on. The number of bolts used to secure both designs of engine deck was reduced from 36 to 18 at the same time. The empty dockets for the bolts were to be plugged until the stocks of those that had already been machined for 36 retaining bolts were exhausted. M.N.H. would also start to fit a simplified design of armoured cover for the ventilator on the engine deck, this was fabricated from 4 flat sections of armour plate that eliminated the need to bend the armour plate on the original design. M.N.H. would fit the new 665mm self cleaning *Leiträder* (idler wheels) to the Panthers it completed from the beginning of December 1944. *Absatzkrümmer* hoods were fitted to the *Flammenvernichter* on the majority of Panther completed by M.N.H. from the end of January 1945 on, these could be back fitted to Panthers completed earlier but there is no evidence so far that this was done.

Daimler-Benz Panther *Ausführung* G - March 1945



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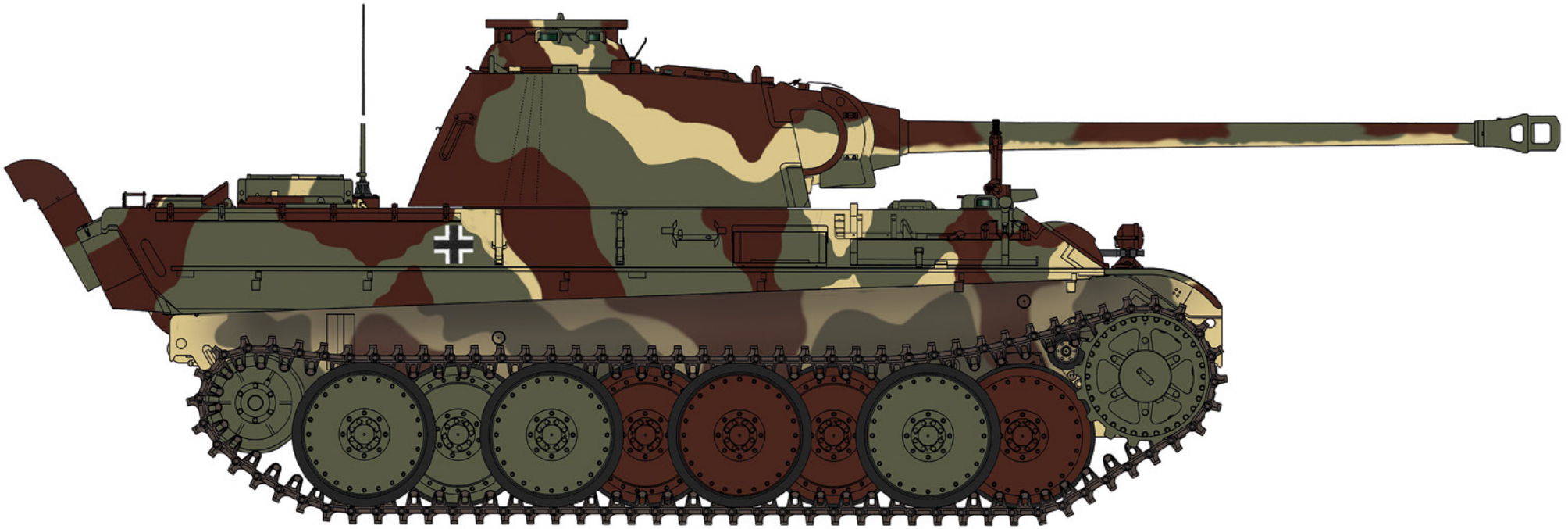

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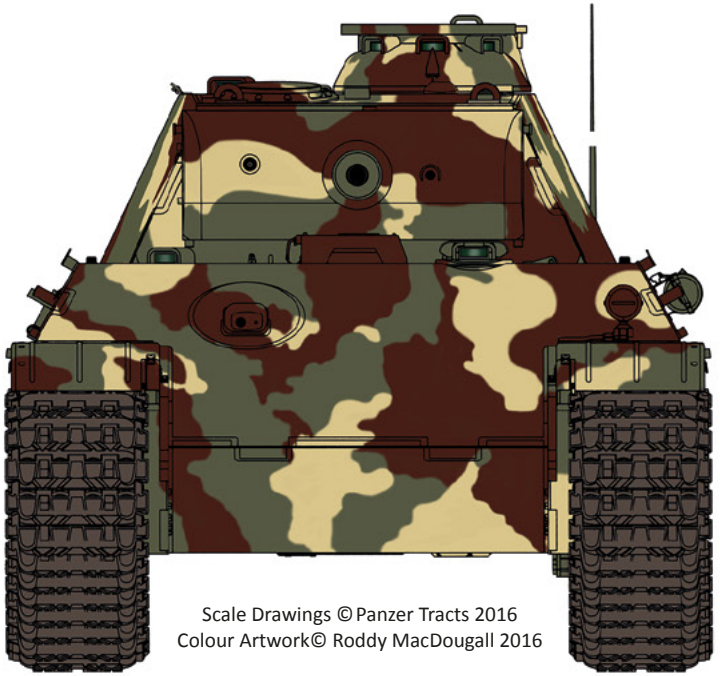

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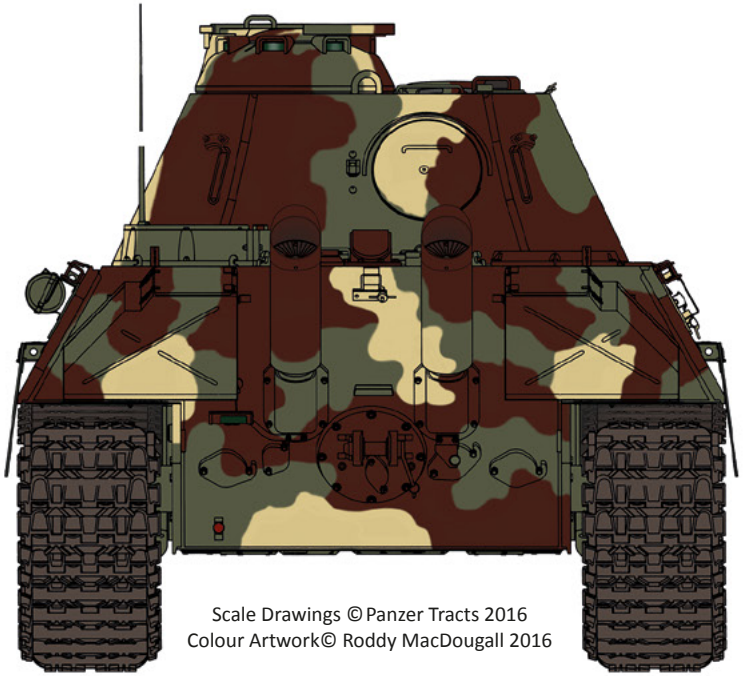

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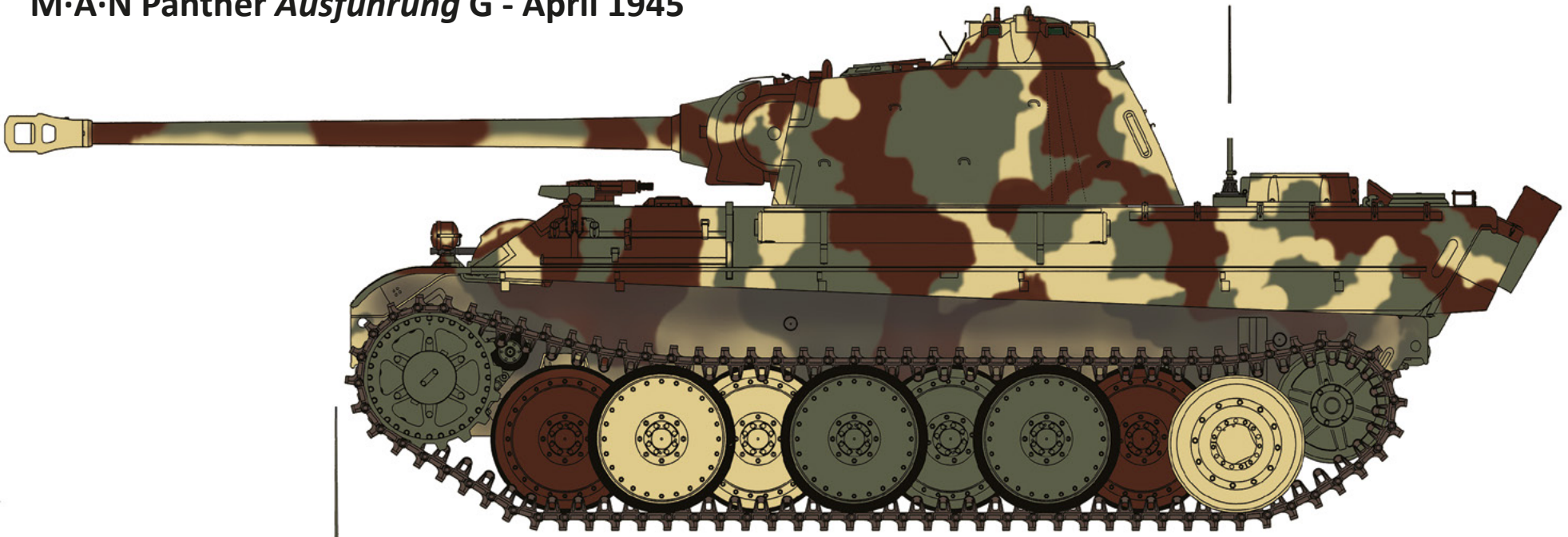
One of the last Panther *Ausführung* G completed by Daimler-Benz in the "Classic" factory applied *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 camouflage scheme. This is one of a handful of vehicles that left Daimler-Benz's *Werke* 40 at Berlin Marienfelde during the Battle for Berlin and subsequently issued to I./Pz.Rgt. 29 without any *Balkenkreuze* national markings being applied. It has all of the features present on the Panthers completed by Daimler-Benz from the end of December on including the spare wheel stowage brackets on the *Turm* rear quarters. It was fitted with *Flammenvernichter* and would probably have had *Absatzkrümmer* hoods fitted to these when it left the assembly plant. Readers should note that these are included for illustration purposes only, their dimensions and the method of attaching the hoods to the rest of the exhaust system have not been determined with certainty. It has been partially prepared for I.R. use with the mounting points for the 4 pin Bosch lamp connector on the starboard side of the gun mantle. The commander's cupola has a ring for mounting the *Fliegerbeschussgerät* anti aircraft mount for and M.G.34 machine gun, the ring was fitted to all Daimler-Benz Panther *Ausführung* G. The *Turm* roof has an aperture for the gun control tape that is protected by an armoured horseshoe welded in front of the commander's cupola. The vehicle is fitted with the original 600mm Leiträder design and has the standard 24 rim bolt road wheel design.

This Panther was abandoned in the Charlottenburg district of Berlin which is just west of the Tiergarten park in the centre of Berlin and the scene of some of the fiercest fighting in the city. It would be photographed several times in varying states of decay and disassembly after being abandoned prior to being shipped to the Soviet Union as scrap. At least one of these photographs was taken with colour film so that we are confident of the shape and placement of the various colour fields. There is little evidence that partially completed vehicles were issued to or commandeered by the troops fighting in the final battle for Berlin. The only noticeable omission on a handful of vehicles are the *Balkenkreuze* national markings mentioned earlier and a single Panther in the centre of Berlin that did not have a gun cleaning tools tube fitted but does have a *Balkenkreuz* centrally located on the port side of the *Fahrgestell*. The *Rotbraun* RAL 8017 colour field on the upper starboard side of the *Turm* of the Charlottenburg Panther is a little unusual for a Daimler-Benz Panther, the deep trough at its lowest point is typical of the "Classic" standardised factory applied camouflage at M·A·N. The *Rotbraun* RAL 8017 on the chamfer around the convex section of the starboard trunnion armour is frequently found on Daimler-Benz Panthers completed between September 1944 and April 1945 as is the *Dunkelgelb* RAL 7028 lobe above and to the starboard side of the *Kugelblende* on the glacis plate.

M·A·N Panther *Ausführung* G - April 1945



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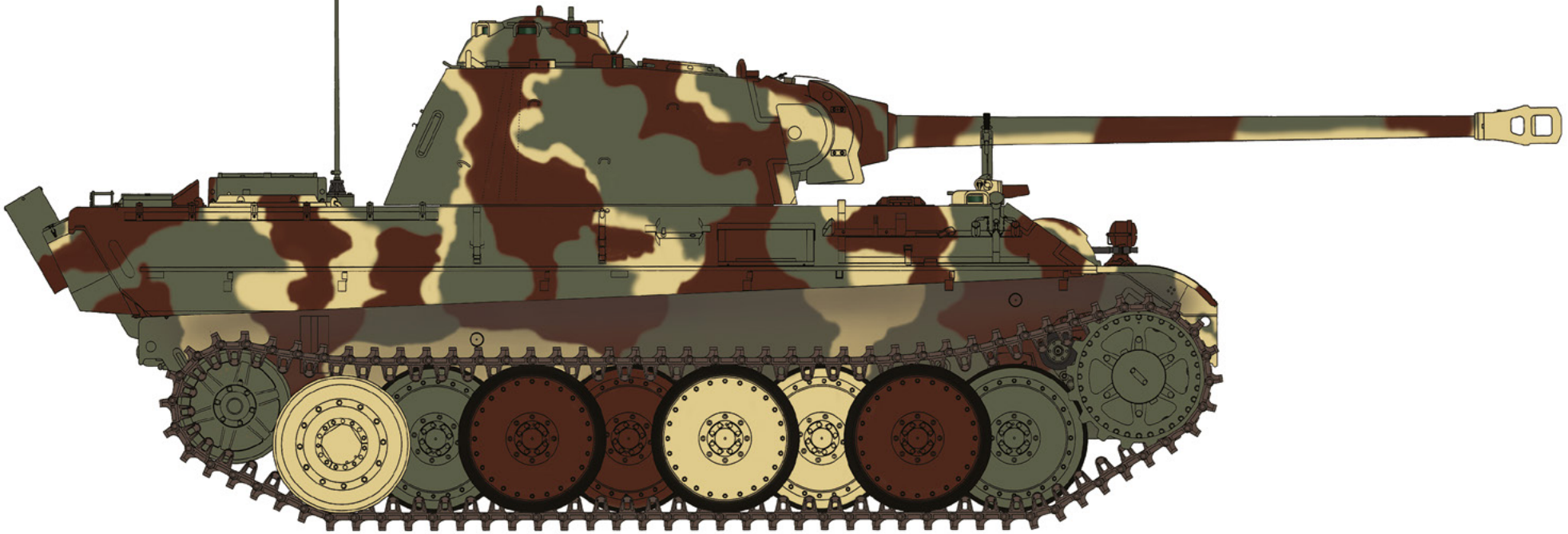

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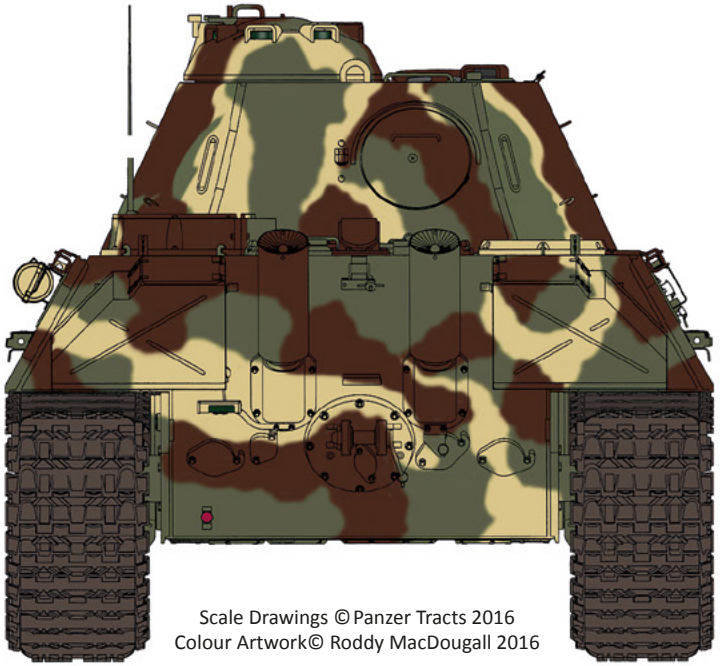

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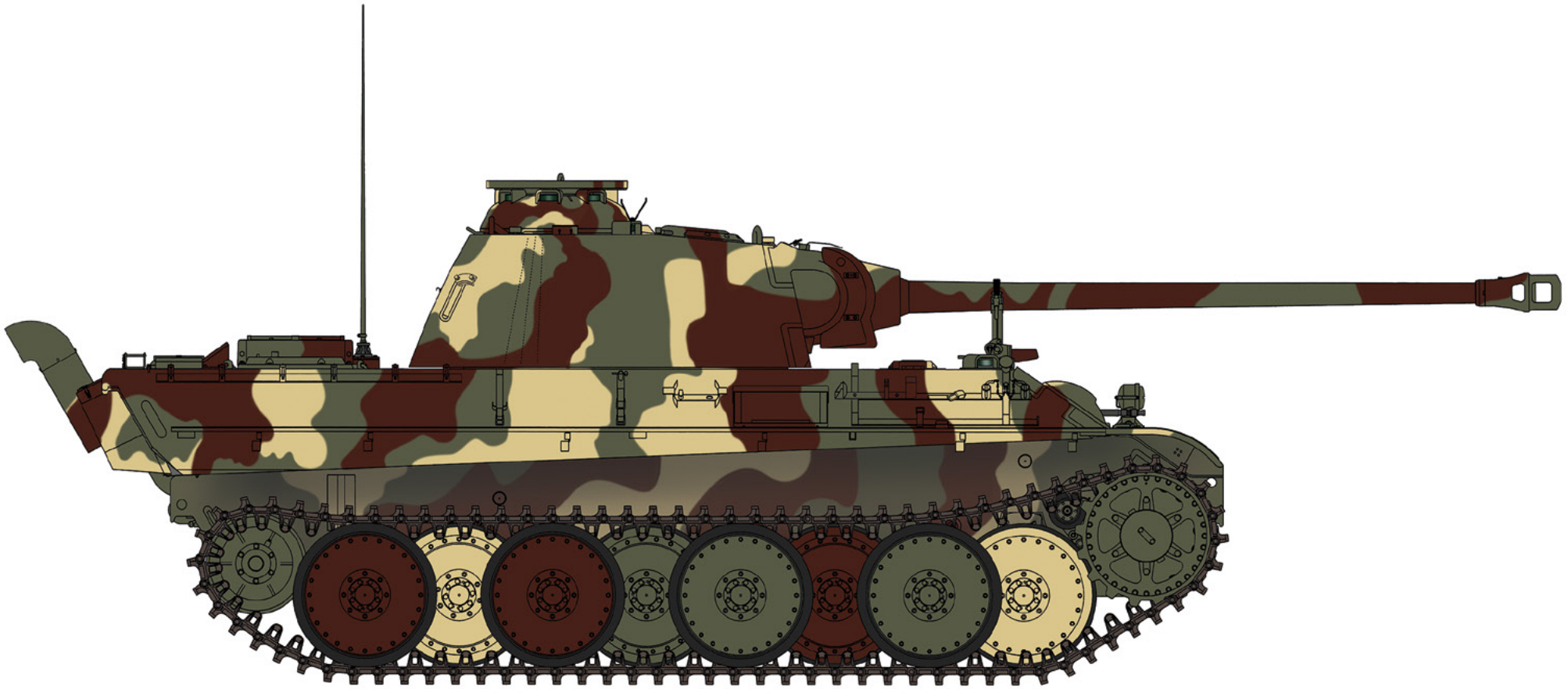
A small number of Panthers completed by M·A·N at Grafenwöhr are finished in a new camouflage pattern that consisted largely of *Dunkelgrün* RAL 6003, this is another name used for *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 with an inconsistent percentage of *Dunkelgelb* RAL 7028 between vehicles. This new camouflage pattern had sharp very tightly sprayed edges to the colour fields on this vehicle. Most of the vehicles completed around the same time had true sharp edges to the colour fields, these were also significantly less elaborate than this Panther which was abandoned in Franconia in the last few days of the war. This scheme predates that used on the last circa 15 to 20 Panthers completed by M·A·N at Grafenwöhr which had a camouflage scheme consisting of *Dunkelgrün* RAL 6003 with *Rotbraun* RAL 8017 that has a true sharp edge to the colour fields. Most of these Panthers were fitted with the forged armoured exhaust elbow, the *Flammenvernichter* were not fitted with *Absatzkrümmer* hoods. This new component was not fitted to any of the series production *Ausführung* G completed by M·A·N. All of the Panthers completed by M·A·N from the end of December 1944 on were fitted the *gummigefederte Stahllaufrollen* on their 8th road wheel stations. The deletion of the rear shock absorbers presented something of a problem as they had been found to be necessary when the original design was conceived. The Heeres-Waffenamt specified in November 1944 that the reinforced Siepmann swing arm (48393-40) was to be used on the 8th road wheel stations if stocks were available. It was also specified for use with the 800mm diameter *gummigefederte Stahllaufrollen*. They further specified that the normal Siepmann swing arm (48303-30) was only to be used with the standard "light weight" road wheels on the 7th and 8th road wheel stations and not with *gummigefederte Stahllaufrollen*. The addition of an extra 60mm of clearance from the standard 860mm diameter road wheel would alleviate some of the problems caused by the vertical travel of the wheel forcing the tracks into the sponson floor while moving at speed over rough ground when the rear shock absorber was not fitted. If sufficient energy built up in the suspension system when the vehicle reached its "resonant frequency" the tracks can whip violently against the sponson floor as the energy cannot be dissipated by the undamped suspension system. This effect can be caused by relatively minor undulations in the terrain and has more to do with their frequency and the vehicles speed than the severity of the terrain being traversed.

Daimler-Benz Panther *Ausführung* G - March/April 1945



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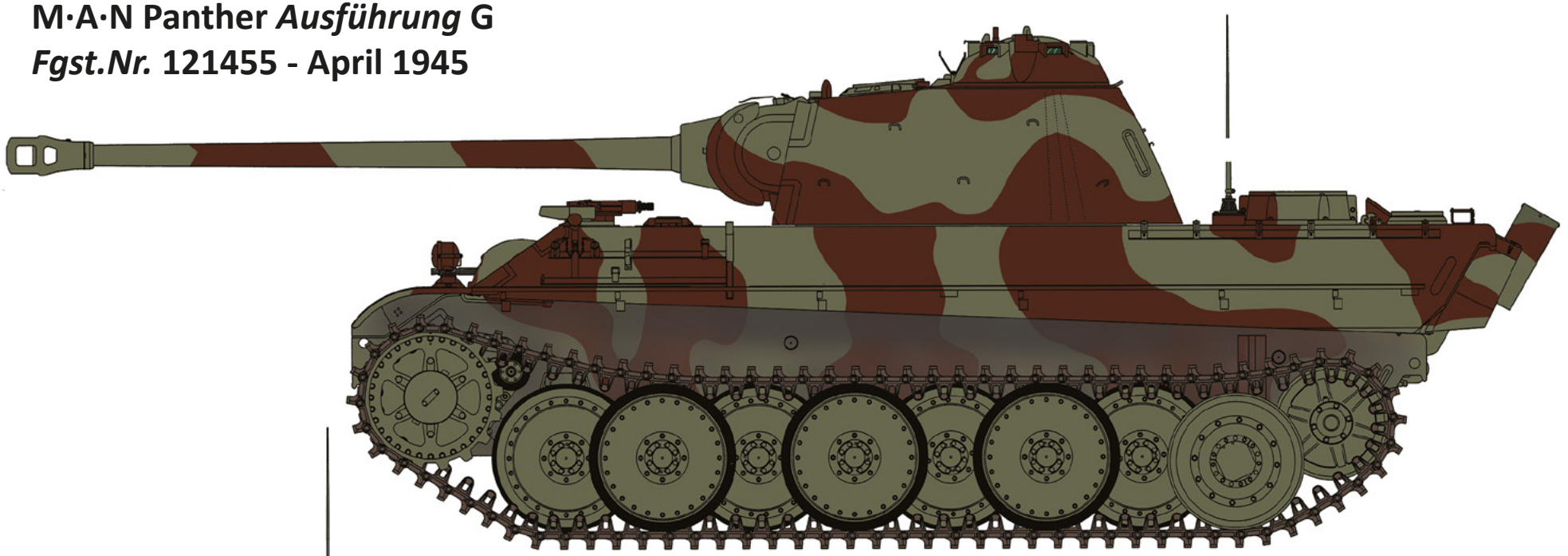
There are several photographs that show that at least two of the last *Ausführung* G Panthers completed by Daimler-Benz that were issued to the troops fighting in the final battle for Berlin were completed in a new factory applied camouflage scheme. None of these vehicles had any *Balkenkreuze* national markings, tactical numbers or unit insignia visible. The camouflage scheme consists of *Dunkelgelb* RAL 7028, *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 with tightly sprayed edges to the colour fields. This new camouflage scheme has colour fields that are similar in placement, shape and size to the schemes used on the last Panthers completed by M·A·N. They have *Absatzkrümmer* hoods over the *Flammenvernichter* (flame suppressing exhausts). Readers should note that these are included to complete the illustration, their exact dimensions and the method of attaching the hoods to the rest of the exhaust system have not been determined with certainty. These Panthers have small 600mm diameter *Leiträder* (idler wheels) and partial I.R. preparation, there is still no real evidence that the FG 1250 was ever completed in order for it to be deployed in combat. These Panthers had the mounting brackets for carrying spare road wheels on the *Türme* sides that were unique to Daimler-Benz. These are the last Ausführung G Panthers that would be completed by Daimler-Benz who had already started assembly of Panther *Ausführung* F *Fahrgestell*, none of which were completed before the assembly plant in Marienfelde was overrun by Soviet forces in late April 1945.

The last twelve Panthers completed by M·A·N and accepted for service with the *Wehrmacht* were issued to I./Pz.Rgt. 3 at Grafenwöhr on 3rd April 1945. These Panther were then involved in Combat along with troops from Kav.Ers.Abt. 20 at Steinach and der Saale between 6th and 8th April 1945. Following this the surviving crews and vehicles withdrew via Traunstein southern Germany to Salzburg in Austria. Troops from I./Pz.Rgt. 3 were then either involved in a skirmish outside Salzburg where another three Panthers would be lost or more likely destroyed by their crews after running out of fuel. Photographic evidence indicates that the last four Panthers appear to have been surrendered to Allied troops intact on 4th May 1945. This Panther was finished in the final two tone camouflage scheme consisting of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 applied by M·A·N personnel at Grafenwöhr. Final assembly had been taking place at Grafenwöhr following the heavy RAF bombing raid at the M·A·N plant in Nürnberg at early January 1945. This Panther was photographed next to the Gärtnerei Ferdinand Altfuldisch on the outskirts of Steinach an der Saale following its loss in early April 1945. It has the roughly painted flat topped "A" marking applied to the external travel lock on Panthers assembled by M·A·N indicating their acceptance by the *Heeres-Abnahmestelle* inspectors and the *Balkenkrueze* national markings applied to the front corners of the *Fahrgestell*.

The colour fields that make up the camouflage scheme on this Panther have sharp edges. In common with all Panthers completed following the introduction of factory applied camouflage schemes the lower Fahrgestell sides have been camouflaged prior to the installation of the running gear. This Panther was fitted *gummigefederte Stahllaufrollen* on its eighth road wheel stations. The remnants of the hub assembly necessary for the installation of these wheels can be seen just ahead of the 655mm diameter self cleaning *Leitrad* (idler wheel). The commanders cupola has the post mount for the redesigned *Fliegerbeschussgerät* and there were five foliage rings welded to each side of the *Turm*. This Panther has been partially prepared for use with FG 1250 I.R. equipment. It was also fitted with a gun cleaning tools tube on the port side of the *Fahrgestell,* this is clearly visible in other photographs of this Panther and is noteworthy as not all of the last twelve Panthers completed by M·A·N were fitted with this tube.

M·A·N Panther *Ausführung* G
Fgst.Nr. 121455 - April 1945



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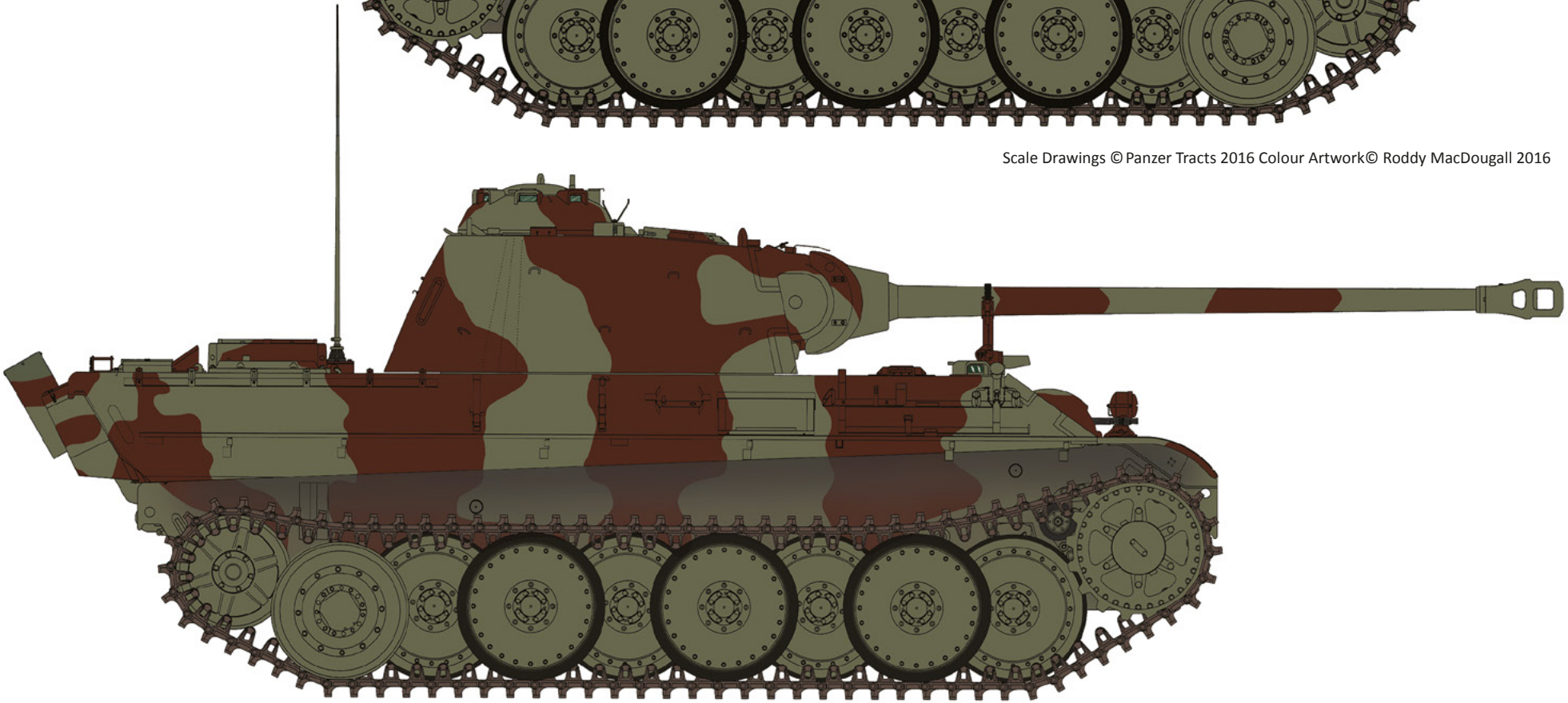

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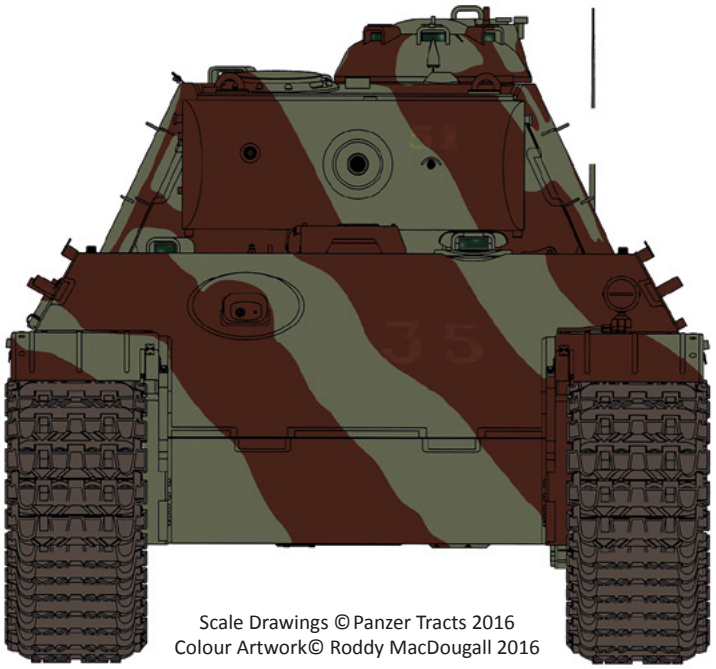

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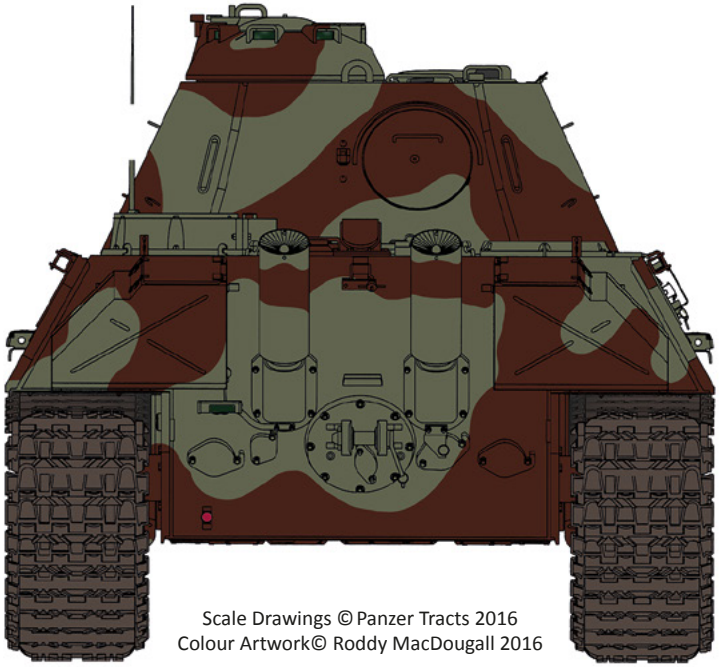

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Panther *Fgst.Nr.* 121455 was the last vehicle known to have been completed by M·A·N in April 1945. There is no *Heeres-Abnahmestelle* stamp on the vehicles data plate indicating it was never accepted by this organisations inspectors for service with the *Wehrmacht*. This Panther was finished in the two tone camouflage scheme consisting of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017 by M·A·N personnel at Grafenwöhr. The camouflage scheme applied to the last circa 15 to 20 Panthers completed by M·A·N at Grafenwöhr has a true sharp edge to the colour fields as opposed the sprayed edges used prior to this. There is considerably greater variation in the size and location of the colour fields used on these last Panthers than those previously found on Panthers assembled by M·A·N. They do however all use a similar ratio of *Olivgrün* RAL 6003 and *Rotbraun* RAL 8017. It is likely that given the war situation, the finish was applied according to a set of written guidlines rather than from a template sent out from the *Heeres-Abnahmestelle*. The urethane synthetic resin paints used for the camouflage were incredibly thin, markings on sub components could be seen reasonably clearly as the paint used to apply these stood slightly proud of the surface. This would result in the paint wearing off these slightly faster than surrounding areas so that markings such as the *Wanne* number can often be seen. All Panthers completed by M·A·N from the end of December 1944 on were fitted the *gummigefederte Stahllaufrollen* on their eighth road wheel stations. The ring for the *Fliegerbeschussgerät* had been replaced with a simplified post mount and the foliage rings welded to the *Turm* sides that were fitted from the end of January 1945 on to the end of the war. This Panther has been partially prepared for I.R. use with a horseshoe armoured guard welded on the *Turm* roof in front of the commander's cupola, this protected the steel tape that provided gun control information from the FG 1250 sight to the gunner on the original design for fitting the FG 1250 to the Panther. It also has the rectangular steel mounting points for a weatherproof socket for an I.R. lamp that was be powered via a lead from the *Turm*, this had a standard four pin Bosch electrical connection that was also used for Bosch headlamps. It was fitted with a standard *Gepäckkasten* in place of the armoured stowage box on the *Fahrgestell* rear plate used on Panthers that were fully prepared for use with I.R. night vision equipment. There are numerous photographs of this Panther taken outside the Imperial Cinema at the Karlsplatz in Munich where it was taken by U.S. forces after it was surrendered to them outside Salzburg.

The Last Leviathan, the last Panther known to have been completed during the war was Panther *Fgst. Nr.* 121455. It was photographed in front of the "Imperial Lichtspiele" just off the Karlsplatz in Munich, Bavaria. The gun cleaning tools tube was not fitted to this Panther or a number of the other final Panthers completed by M·A·N in April 1945. U.S. forces entered Munich with little or no resistance on 30th April following the almost complete collapse of organised defence by the *Wehrmacht*. This Panther *Fgst.Nr.* 121455 was subsequently photographed in front of the "Imperial Lichtspiele" just off the Karlsplatz in Munich. The last Panthers completed by M·A·N and accepted for service with the *Wehrmacht* were issued along with a number of Panthers that were serviceable but not fully complete to I./Pz.Rgt. 3 on 3rd April 1945. There are at least two photographs of Panther *Fgst.Nr.* 121455 taken just after its capture showing it in a field in open country outside Salzburg in Austria. It has been parked in close proximity to three other new M·A·N assembled Panthers These Panthers were surrendered by their crews to troops from the U.S. 232nd Inf.Reg. 42nd Inf. Div. in the vicinity of Salzburg at the end of hostilities following which they were parked in a field where the photographs were taken. For reasons that have not yet been fully explained Panther *Fgst.Nr.* 121455 was then moved into Munich by U.S. troops and subsequently abandoned in the Karlsplatz. It remained in the Karlsplatz until late September 1945 when it was moved along with other examples of German armour to a vehicle collection point at the behest of General George S. Patton. It was his intention to ship these vehicles back to Fort Knox in the United States where they would be preserved and eventually form the nucleus of a collection that would be named after General Patton following his death. Although there is no *Heeres-Abnahmestelle* stamp on the vehicles data plate, it is likely that Panther *Fgst. Nr.* 121455 was amongst the Panthers issued to I./Pz.Rgt. 3 at Grafenwöhr along with the 12 Panthers officially issued to this unit. Some of the Panthers issued to I./Pz.Rgt. 3 were not fully complete with at least one having the frames for its *Gepäckkasten* fitted but not the boxes themselves. The remaining Panthers from I./Pz.Rgt. 3 were eventually turned over to U.S. forces in Salzburg when the remnants of the *Abteilung* surrendered there. We cannot completely dismiss the anecdotal story that Panther *Fgst.Nr.* 121455 was commandeered by troops from II./Pz.Rgt. 22 or another unit other than I./Pz.Rgt. 3 prior to 20th April 1945 when Grafenwöhr was overrun by U.S. forces. It is possible that Panther *Fgst.Nr.* 121455 was used by II./Pz.Rgt. 22 who were attached to *Kampfgruppe* von Hobe (*Panzerkampfgruppe* XIII) after picking up new vehicles on 1st April. This unit had a command post near the Karlsplatz in Munich prior to 30th April 1945 and the surviving troops from this unit also

surrendered to U.S. forces in the vicinity of Salzburg. However the anecdotal evidence from an "eyewitness" states that this Panther was abandoned in the Karlsplatz by its German crew following combat nearby. The "story" that accompanies this narrative has the commander of the Panther running out of fuel and ammunition at the Karlsplatz, collecting his belonging and setting of for home on foot along with his crew, no real evidence has been found to support this "story". However, there is a lot of evidence to suggest this is not the case, the last Panthers completed by M·A·N and accepted for service with the *Wehrmacht* were issued to I./Pz.Rgt. 3 on 3rd April 1945, two days later,than those Panthers issued to II./Pz.Rgt. 22 significantly reducing any possibility that it was indeed issued or commandeered by troops from II./Pz.Rgt. 22. This Panther was eventually shipped to the United States where it remained on display in more or less its original condition until it was used as a source of spare parts for what can best be described as a novelty attraction when the Panther II *Versuchs-Fahrgestell* was "upgraded" using its *Turm* and one of its wheels. The *Turm* from another similar M·A·N assembled Panther that was also shipped back to the United states was fitted to Panther Fgst.Nr. 121455 prior to it being stored outside and allowed to deteriorate. (USAHEC & NARA via Darren Neely)

9.

A "G" marking started to appear on the glacis plate, underneath the *Schürzen* rail at the rear of the port side of the *Fahrgestell* midway between the end of the rail and the last bracket or on the hull rear of some Panthers from September 1944 on through to early 1945[1]. This was usually roughly painted in black or white but was occasionally neatly applied with a stencil. Various explanations for this marking have been propounded over the years ranging from identifying a particular unit or commander to indicating a specific *Rollbahn* or route that was assigned to particular units during the Ardennes Offensive. However, none of these hypotheses are capable of surviving further scrutiny in detail.

A full maintenance plan which included specifying important consumable items that were to be used was developed for the Panther from the initial stages of the design. This maintenance plan specified *Akorol* exclusively as the corrosion protection additive for the Maybach HL210 motor's cooling system. *Akorol* was the trademarked name for a corrosion protection chemical compound that was first registered by the chemical giant I.G. Farben A.G. on 9th August 1938[2]. This powerful chemical compound contains substantial quantities of Potassium Dichromate and Potassium Chromate. It was formulated to prevent corrosion from forming in the vehicles cooling system, suspending any debris or mineral deposits harmlessly within the mixture. This would then be easily flushed from the cooling system when the engine was drained during scheduled maintenance. This is a particularly important consideration on the Maybach HL210 and HL230 engine series as the cooling jackets on these engines have extremely tight engineering tolerances. *Akorol* is packaged in stout impregnated cardboard tubes known as a "*Rolle*" (roll) containing 10 lozenges, each of which is suitable for treating 1 litre of coolant. The cap of the packaging is prominently marked with "*Nicht mit Frostschutzmitteln wie Glysantin verwendbar*" (Not to be used with the antifreeze solution *Glysantin*).

1 This marking would also appear on Jagdpanthers, Tiger II *Ausf.* B's and Bergepanthers issued to numerous units on both fronts.

2 *Akorol* is still listed as a registered trademark for BASF SE: *AKOROL* (DPMA). REF: DE1003456.*AKOROL*. Form of marks: word mark. Nice. Classification: 1 registration date: 11th June1980 filing date: 24th November1979. Owner: BASF AG, 67063 Ludwigshafen

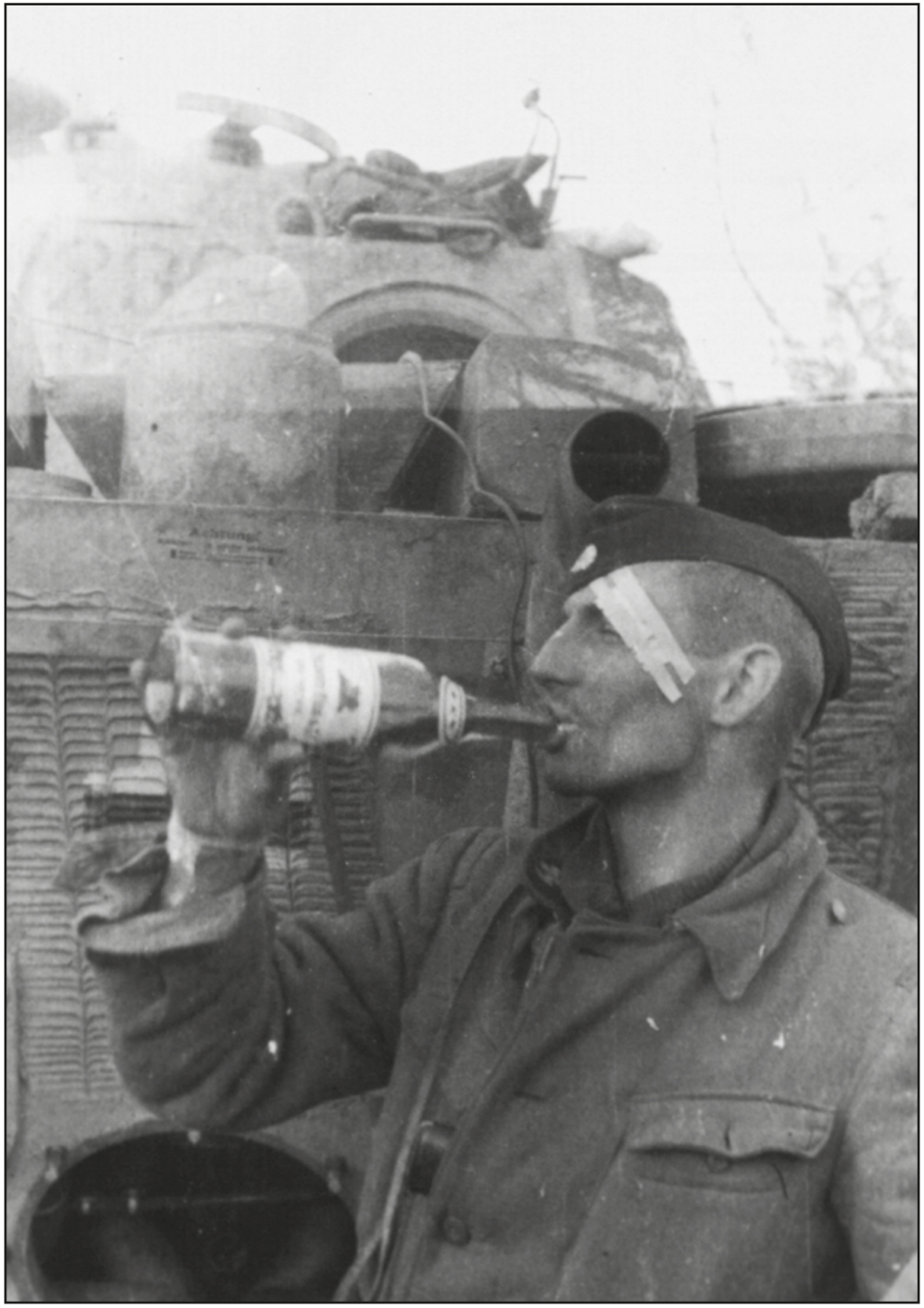
Akorol is mentioned on drawing 021-48399-338 along with the manual "*D635/80 Gebrauchsanweisung für Akorol*" (User Manual for *Akorol*). Both the manual D635/80 along with 30 rolls of *Akorol* are listed on the "*TL 21/7064 Entwurf Satz Fahrzeugausrüstung für Fahrgestell des Pz.Kpfw. Panther Ausf. D, A und G v. 14.4.44*" (TL 21/7064, Set of vehicle equipment for the Fahrgestell of Pz.Kpfw. Panther Ausf. D., A and G from 14th April 1944). This document forms part of the *Lieferschein* documentation completed for all Panthers accepted for service with the *Wehrmacht*. *Akorol* and the manual D635/80 also formed part of the equipment issued along with other types of vehicles such as the Tiger series as well as the Panzer IV *Ausf*. J which was fitted with a Maybach HL120 TRM engine. The manual "*D635/80 Gebrauchsanweisung für Akorol*" dated 1st March 1944 indicated that when a vehicle's cooling system was filled with an *Akorol* mixture the radiator was to be clearly marked with the text "*Akorol*". This can be seen adjacent to the radiator filler cap on vehicles in period photographs. A small number of Panthers assembled by M·A·N had a warning regarding the use of *Akorol* in the cooling system stencilled above the sheet metal brace between the exhaust stacks or more frequently on the engine deck "*Achtung Kühlwasserzusatz Akorol".*

The *Wehrmacht's* experience of its first winter in the Soviet Union had led the *Oberkommando des Heeres* (Supreme High Command of the German Army) to instruct the *Heeres-Waffenamt* to investigate the best type of antifreeze suitable for operations in extreme cold temperatures. Following extensive practical testing that included experiments with Diesel fuel as an antifreeze, the *Heeres-Waffenamt* had determined that there were only two chemical compounds suitable for use in extreme cold temperatures, *Glysantin* and Ethanol. Large stocks of Soviet antifreeze solutions had been captured during the *Wehrmacht*'s rapid advance, however due to the unknown chemical composition of these compounds; the use of these stocks was strictly prohibited without prior authorisation from the *Heeres-Waffenamt*.

There were problems associated with the use of Ethanol, it was found that when the coolant reached a temperature of 70° C the Ethanol content started to vaporize so

its frost protection capabilities deteriorated sharply. This vaporization also had a detrimental effect on the amount of corrosion and scaling that occurred in the engine's cooling system. It was widely used amongst units from the *Ersatzheer* as well as front line units due to the constant shortage of sufficient supplies of *Glysantin*. The coolant additive *Glysantin* is a Mono ethylene based frost and corrosion inhibitor patented by I.G. Farben A.G. on 31st October 1929. It is still produced by BASF and is the most common automotive combustion engine coolant in Europe. *Glysantin* had been used by the *Wehrmacht* for several years, however demand had always outpaced the available supplies leading the *Heeres-Waffenamt* to issue instructions to units to prioritise the use of the available supplies of *Glysantin* according to the need to keep key vehicles combat ready for all weather conditions. There were strict instructions regarding the use of *Glysantin* to optimise the available supplies and its performance in cold conditions. A set of climatic maps were issued to the units that was used to determine the ratio at which *Glysantin* was to be mixed with the coolant and when this should occur. *Glysantin* is an extremely effective frost and corrosion inhibitor in extreme cold conditions if mixed in the correct ratios. If the *Glysantin* content was too low then the coolant would thicken reducing its ability to circulate around the cooling system. This would often lead to serious engine damage and possibly the loss of the vehicle. If the *Glysantin* content was lower than 30% then it was probable that the coolant would still freeze, particularly in the extreme temperatures found on the Eastern Front. Raw turned into a thick gelatinous paste at -14° C and needed to be warmed to raise its viscosity enough to decant it from its container. It was also flammable so that the instructions for its use specified that it was not to be warmed with a naked flame. If the ratio of *Glysantin* to water exceeded 60% then there was no additional frost protection benefit, however it did affect the coolant's ability to absorb heat from the engine and the radiator's ability to dissipate this. The corrosion protection elements in *Glysantin* had descaling properties which could cause leaks in the vehicle's cooling system around gaskets, seals and connections. As a result of this the driver was required to adhere to a strict maintenance schedule that included checking the coolant daily to ensure that the levels remained constant. He was also tasked with checking the *Glysantin* ratio on a weekly basis during the cold weather season.

The equipment necessary to do this was the "*Glysantinspindel 43 aus preßstoff mit eingebautem thermometer am Meßbehalter*" (*Glysantinspindel* or *Glysantin*



Some Panthers assembled by M·A·N had a warning regarding the use of Akorol in the cooling system stencilled above the sheet metal brace between the exhaust stacks or more frequently on the engine deck "*Achtung Kühlwasserzusatz Akorol*" (Caution coolant additive Akorol). Unfortunately the stencilled text below this is illegible. The injured crewman is Oscha. Walter Ropeter from 2./SS-Pz.Rgt. 1 with his Panther in the Ukraine in early 1944. (Thomas Fischer via Timm Haasler)

Left: The *Akorol* Rolle is 90mm long x 22mm diameter and each pack contains 10 tablets or lozenges. Each of these is sufficient to treat 1 litre of coolant. When *Akorol* is mixed with the cooling water it gives this a pronounced green hue that the driver was instructed to look for, this reduced the chance of *Glysantin* accidently being mixed with coolant that had already been treated with *Akorol*. There were 30 *Akorol Rolle* issued as part of the standard equipment with all new Panthers. (Roddy MacDougall)

Right: *Akorol* was packaged in stout impregnated cardboard tubes known as a *"Rolle"* (roll).The cap of the packaging is prominently marked with *"Nicht mit Frostschutzmitteln wie Glysantin verwendbar"* (Not to be used with the antifreeze solution *Glysantin*). *Akorol* is a powerful chemical compound that contains substantial quantities of Potassium Dichromate and Potassium Chromate. It was formulated to prevent corrosion from forming in the vehicles cooling system, suspending any debris or mineral deposits harmlessly within the mixture. A 10 cent Euro coin has been used to provide some scale in the photograph. (Roddy MacDougall)

The *Pz.Bef.Wg.* Panther tactical number 154 in the foreground of this photograph was knocked out along with Panther tactical number 327 (*Fgst.Nr.* 121146, see page 196) at the road junction on the N658 and the road to Wirtfeld on the outskirts of Krinkelt in Belgium. The *Pz.Bef.Wg.* Panther was completed by M·A·N in October or early November 1944. The port and starboard sides of the *Pz.Bef.Wg.* Panther have been painted in a standard rendition of the standardised "Classic" factory applied camouflage scheme used by M·A·N from late September until the last few days of November 1944. The glacis plate does not have some of the characteristic features of this scheme, it lacks the *Dunkelgelb* RAL 7028 lobe above the *Kugelblende* and the *Dunkelgelb* RAL 7028 colour field is reminiscent of the initial vehicles completed by M·A·N in this scheme during late September 1944. The glacis plated has been marked with a black "G" indicating that the motor coolant has been treated with *Glysantin*. (Haasler, MacDougall, Thomson & Vosters)

Viscometer model 43 made from plastic with a built-in thermometer on the measuring container) which was issued with the vehicle. The driver would draw off some of the coolant after the engine had reached its normal operating temperature and place it in the *Glysantinspindel*, using the built-in thermometer he would wait until it had cooled to 20° C and then read the scale on the Viscometer element that measured the *Glysantin* concentration of the coolant. If the *Glysantin* ratio was within the acceptable tolerances as per the tables in "*D659/50 Panzerkampfwagen im Winter*" it was replaced and the levels checked, if it was found to be either under or over, the level was topped up with either water or *Glysantin* until the correct ratio was achieved. The instructions also call for the *Glysantin* to be drained from the vehicle's cooling system at the end of the cold season and retained in a suitable container for reuse. While *Glysantin* has excellent corrosion inhibiting characteristics, the high Mono Ethylene Glycol based content made it unsuitable for use in a 23 litre petrol engine in the height of a European summer. This has a significant impact on the heat transfer capabilities of the coolant. The practical effect of this would be similar to a major reduction to the size of the cooling system; this is not a problem in the depths of a mid European winter where the ambient temperature is already well below freezing. However, at any ambient temperature over 15° C this starts to become a real problem that is exacerbated incrementally with every degree the ambient temperature rises.

The Panther's cooling system was to be refilled with coolant treated with *Akorol* for the temperate season. The manual "*D659/50 Panzerkampfwagen im Winter*" dated 1st September 1944 clearly states "*Als Frostschutzmittel darf für Panzer nur Glysantin verwendet worden*" (Only *Glysantin* may be used as an antifreeze for Panzers) and its specific use is dealt with in detail on pages 8 to 11. Instructions for the use of *Glysantin* can also be found in "*D659/51 Panzerfahrer im Winter*" also dated 1st September 1944 where there are instructions on page 5 of this manual that state "*Es ist verboten, dem mit Glysantin gefüllten Kühler Akorol zuzusetzen*" (It is forbidden to add *Akorol* to coolant that has *Glysantin*). If *Glysantin* is mixed with *Akorol* it can cause a powerful chemical reaction leading to serious engine damage[3]. This was considered important enough that, as previously mentioned, the protective packaging for *Akorol* was prominently marked with "*Nicht mit Frostschutzmitteln wie Glysantin verwendbar*" (not to be used with *Glysantin*) on the lid. *Glysantin* was an important part of the winterisation of armoured vehicles that is frequently mentioned by name in official *Heeres-Waffenamt* documents and maintenance publications. It was important that vehicles that had been filled with a *Glysantin* mixture were clearly marked so that no attempt was made to use any other chemical mixture or compound particularly any that contained *Akorol* to top up the cooling system.

There are various armoured vehicles that have "*Glysantin*" stencilled on the glacis plate including *Jagdtiger Fgst.Nr.* 305001, Tiger II Ausf.B at *Kummersdorf*, *Jagdpanzer* 38T *Fgst.Nr.* 323211 and Panther *Fgst.Nr.* 121306 which has the legend "*Glysantin geschützt*" (protected by *Glysantin*) stencilled underneath its *Kugelblende* as well as numerous Panthers and Tiger II *Ausf*. B that are clearly marked with the letter "G" on the glacis plate, *Fahrgestell* side or rear *Fahrgestell* plate. The "G" and "*Akorol*" markings can also be found on other vehicles including various halftracks.

It should be noted that the white "A" applied to M·A·N vehicles following the *Heeres-Abnahmestelle* inspection and their acceptance for service with the *Wehrmacht* can also be seen along with the "G" marking. The two are not mutually exclusive; however, there is evidence that in some instances the "A" was painted over to avoid the potential for confusion. It would be common practice to remove the "*Akorol*" and "*Glysantin*" (or "G") marking applied in accordance to the instructions in the relevant *D-Vorschriften* (Service Manuals) when the coolant containing the relevant compound was removed at the end of the season. If this was not done then potentially serious damage to the motor and cooling system could easily occur through confusion as to which compound was present in the cooling system if both markings were left on the vehicle. As an aid to preventing this type of accident the manual "*D559/50 Panzerkampfwagen im Winter*" states that coolant treated with *Akorol* had a pronounced green colour that the driver was instructed to look for to ascertain whether it was present in the coolant before adding *Glysantin*.

Opposite Page:

①The map supplied by the *Heeres-Waffenamt* showing the minimum temperatures expected on the Eastern Front.

②The letters correspond to a series of tables that accompanied the map that provided the correct mixing ratio of *Glysantin* to water in the cooling system of vehicles serving in each area. The ratio required to protect the motor from frost damage altered depending on the time of year and a key for each month is provided at the bottom of the tables. *Glysantin* affected the heat transfer capability of the coolant and was to be completely drained from the cooling system at the end of May to allow maximum efficiency during the summer months when the motor would be protected from corrosion and mineral deposits by *Akorol*.

③The two models of *Glysantinspindel*, a type of viscometer used to measure the *Glysantin* content of motor coolant the original glass version was clearly unsuitable for use with front line units so a new version the *Glysantinspindel 43 aus Preßstoff* was developed that was manufactured from synthetic material and incorporated a thermometer in the container side. The buoyancy of the spindel section measured when the coolant was at 20° C gave an accurate indication of the *Glysantin* content of the coolant.

④A screw on lid was provided that prevented inadvertent spills as well as securing all three component parts when not in use. The maintenance schedule for the Panther called for the driver to measure the *Glysantin* content of the coolant using this device once a week during the cold weather season. (4 x NARA via Darren Neely)

3 The current instructions regarding the use of *Glysantin* specifically warn against mixing other coolant additives with *Glysantin* due to the possibility of severe engine damage.

①

Bild 38 Karte mit Gebieten gleicher Tieftemperaturen (eingetreten innerhalb der letzten 20 Jahre)

②

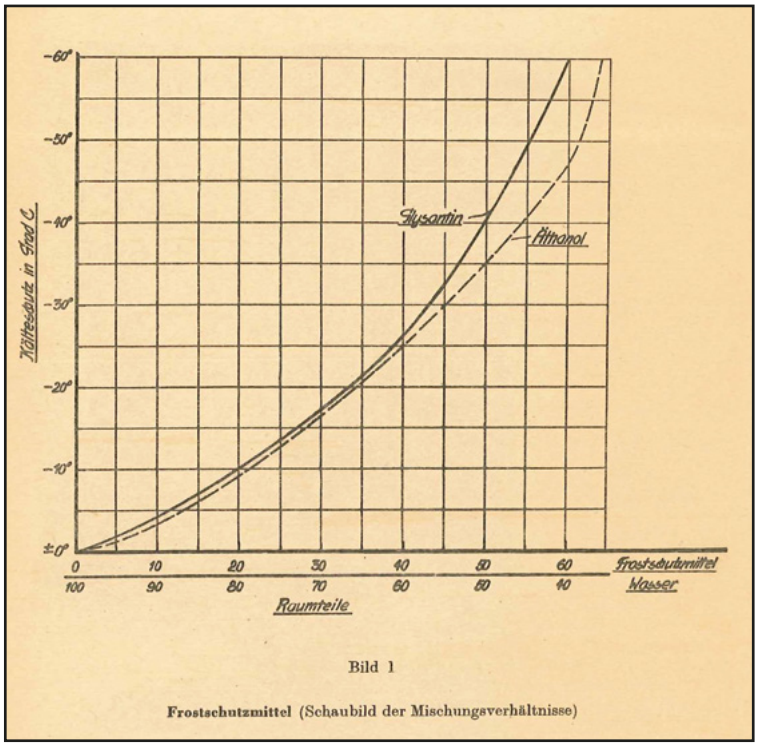


Bild 1

Frostschutzmittel (Schaubild der Mischungsverhältnisse)

③

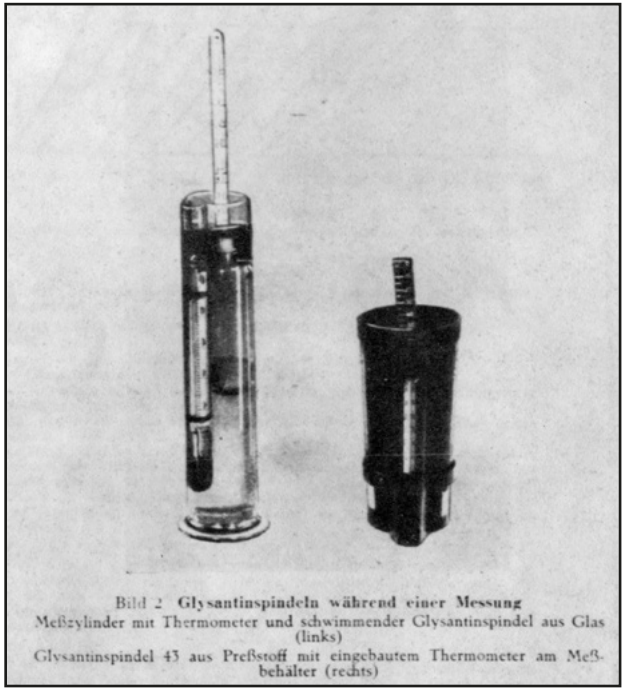


Bild 2 **Glysantinspindeln während einer Messung**
Meßzylinder mit Thermometer und schwimmender Glysantinspindel aus Glas (links)
Glysantinspindel 43 aus Preßstoff mit eingebautem Thermometer am Meßbehälter (rechts)

④

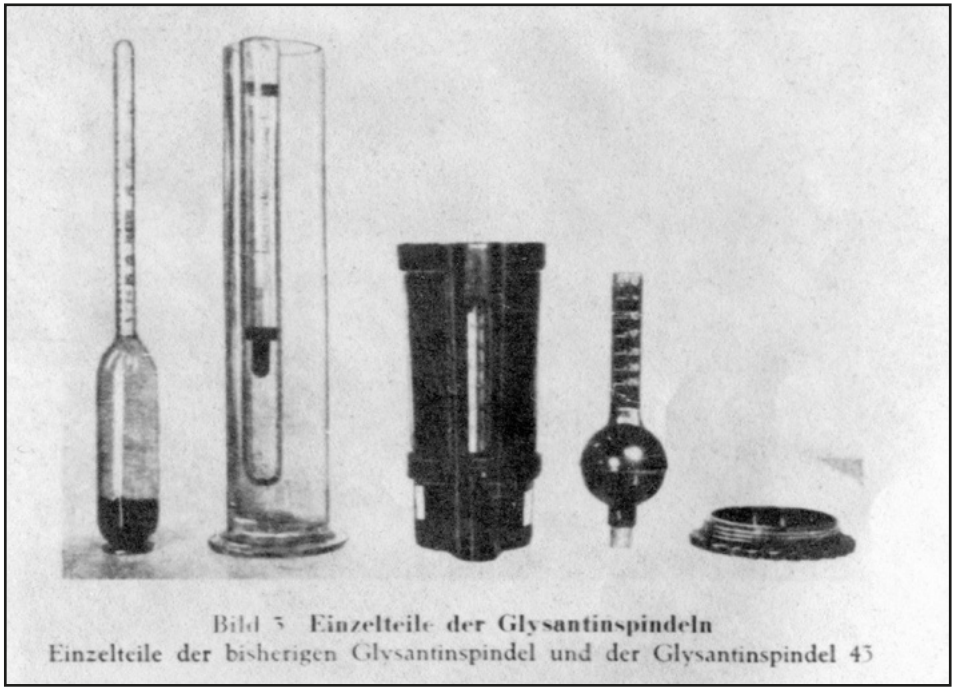


Bild 3 **Einzelteile der Glysantinspindeln**
Einzelteile der bisherigen Glysantinspindel und der Glysantinspindel 43

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• D659/50 Panzerkampfwagen im Winter v. 1.9.44.
• D659/51 Panzerfahrer im Winter v. 1.9.44.
• D2003 7,5 cm Kampfwagenkanone 42 v. 1.7.43.
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PANTHER

EXTERNAL APPEARANCE & DESIGN CHANGES

RODDY MACDOUGALL & MARTIN BLOCK

From authors Roddy MacDougall and Martin Block, with the full assistance of the Panzer Tracts team, comes the most comprehensive study on the Panther tank to date. The product of over 10 years of research and interviews, this is the first book on the Panther to include detailed explanations of factory-specific details such as Zimmerit application and camouflage patterns, reproduced in full colour. Detailed perspective drawings are also used throughout to describe the production timeline of this iconic vehicle, and hundreds of photographs, many of which are published here for the first time, are reproduced in high resolution.

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www.abteilung502.com
Phone: (+34) 941 44 52 28
info@abteilung502.com

8 436535 579889